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The JOURNAL of EXPERIMENTAL EDUCATION

Volume I | JUNE, 1933 | Number 4

CURRICULUM CONSTRUCTION

CONTENTS

Introduction: HARAP, HENRY 293

Curriculum Research: DAVIS, ROBERT A., and WILBUR, MILTON J. 294

Learning Essentials in an Activity Curriculum: HOPKINS, THOMAS L. 298

An Activity Curriculum in a School of Mexican Children: MERIAM, JUNIUS L. 304

Learning the Fundamentals in the Activity Curriculum: COLLINGS, ELLSWORTH 309

Measuring the Skills in an Integrated Program: HOWELL, ETTA; DUNN, MAUDE WILSON; and STOKER, DORA 316

Social Problems as a Basis for a Vitalized Arithmetic Curriculum: BRUECKNER, LEO J. 320

An Activity Analysis of Secretarial Duties as a Basis for an Office Practice Course: TYRRELL, DORIS 323

The Relative Importance of Items of Chemical Information for General Education: WRAY, ROBERT P. 341

Title for Vol. I (complete)
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INTRODUCTION

It is appropriate that this issue of the Journal of Experimental Education should include four papers evaluating one aspect of the outcomes of experimentation with activity curricula. Careful students of education will welcome this attempt at objective evaluation in a field in which there is so much controversy. Activity curricula, in various forms, are making rapid headway in the elementary schools. One of the first responsibilities of the experimenters is to demonstrate, if possible, to the adherents of the traditional curriculum that none of the basic conservative values are sacrificed in the activity school.

The authors include Junius L. Meriam who is one of the early founders of activity schools; Ellsworth Collings who has had continuous contact with project curricula during the past fifteen years; and L. Thomas Hopkins who reports the work of the Lincoln School which maintains, perhaps, the most complete reasearch facilities of all the private experimental schools. The results of experimentation in the public schools is reported by members of the Curriculum and Research Department of the Pasadena, California, Public Schools.

In these studies no attempt is made to evaluate results other than achievement in the traditionally accepted fundamentals. This is probably due to common curiosity concerning such results and to the ease with which they may be measured. Whether the attainment of the intangible values that are claimed for the activity curricula can be satisfactorily measured or whether they should be measured at all remains to be settled in the future.

Leo J. Brueckner analyzes contemporary social issues which involve quantitative thinking and suggests that their inclusion in mathematics courses would vitalize and humanize that subject and contribute to clear and accurate thinking in public affairs.

Doris Tyrrell takes a portion of an old analysis of secretarial duties and traits, and projects the investigation several degrees further with a view to securing guidance in the construction of an office practice course. In addition to frequency, the investigator applies the criteria of importance, difficulty, and desirability of pre-service training.

Robert P. Wray's study is welcome because it pertains to the field of chemistry which has been subjected to a functional test only to a very limited degree. The criteria of usefulness to the layman which the investigator applied are frequency and satisfaction. Davis and Wilbur analyze curriculum research to discover the procedures, sources, and statistical techniques which have been employed in the last ten years.

This issue represents a second phase in curriculum research: the checking on innovations; the evaluation of and the following up of old procedures; and the evaluation of research techniques.

Henry Harap

Henry Harap

CURRICULUM RESEARCH

By
Robert A. Davis and Milton J. Wilbur
University of Colorado

Investigations were studied in the field of the curriculum as reported in theses, surveys and periodicals for the period between 1921 and 1931 which probably represents the greatest stage of research activity in the curriculum. From these sources a sampling of 381 investigations was selected. The studies were analyzed to determine the method used and the tools, sources, statistical devices, and objectives involved in the studies. This procedure furnished a basis for the classification of curriculum research procedures.

THE METHODS OF CURRICULUM RESEARCH

Curriculum research embraces all of the methods found in general educational research. These general methods may be classified as descriptive, analytical, experimental, integrative, historical and philosophical. The distribution of curriculum research according to these classifications is shown in Table I. It will be observed from this table that descriptive and analytical methods predominate.

Educational surveys have included a study of the curriculum. In 1921 a survey was conducted in the schools of Maryland. The procedure used in describing the curriculum was based upon visits to the classrooms by the surveyors, and observation of the functioning of the course of study. These subjective methods may be compared with those used in a survey of the curriculum of Sacramento in 1928 where the curriculum was described in terms of pupil performance as measured by objective instruments, and by the analysis of social needs. This comparison illustrates the trend toward objective methods which is apparent in descriptive research.

The analytical method holds the most prominent position in the field of the curriculum. Analysis as the basis of a course of study is illustrated in an investigation by Hopkins and Kinyon. Through the medium of questionnaires, a large number of mothers and daughters reported their household activities which were reduced to elementary skills and classified to form the nucleus for a course of study. This type of research has been termed functional analysis. A second form may be termed non-functional analysis, an example of which is a study by Spaulding who analyzed six textbooks to determine the nature of the content in arithmetic. Analysis not only lists the qualities

TABLE I
THE DISTRIBUTION OF CURRICULUM STUDIES ACCORDING TO METHODS OF RESEARCH FOR THE ELEVEN-YEAR PERIOD.

Year	Descriptive		Analytical		Experimental		Integrative		Historical		Philosophical		Total
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	
1921	15	.38	11	.28	1	.02	2	.05	1	.02	9	.23	39
1922	16	.35	13	.28			6	.13	1	.09	9	.20	45
1923	2	.20	5	.50			1	.10			2	.20	10
1924	9	.23	14	.36	5	.13	5	.13			5	.13	38
1925	9	.26	17	.50			1	.02	2	.05	5	.14	34
1926	8	.13	38	.65	3	.05	1	.01	3	.05	5	.08	58
1927	11	.21	19	.36	2	.04	5	.09	3	.06	12	.23	52
1928	7	.20	14	.41	6	.17	2	.06	1	.03	4	.12	34
1929	11	.25	13	.29			5	.11	2	.04	13	.29	44
1930	4	.26	5	.33	1	.07			2	.13	3	.20	15
1931	4	.33	5	.42	1	.08			1	.08	1	.08	12
Total	96	.25	154	.40	19	.05	28	.07	16	.04	68	.17.8	381

studied but reduces them to their fundamental elements which is a step beyond description.

The experimental method of research is a verification of all other methods of study. The techniques of experimentation have been used to advantage in several studies. To validate the results of analysis or description it is necessary to test them in actual conditions of the learning situation where the change effected in the pupils may be objectively measured. Experimentation requires measurement of improvement in particular skills, appreciations, and an evaluation of the extraneous factors of learning such as method of teaching or the equipment of the school.

Experimentation in curriculum is found in some of the laboratory schools, but those who use it do not usually indicate methods of measuring results. An example of the objective type of experiment which yields decisive results is one reported by Galchel in which the experimental factor was a course of training in the art of study. This material was presented to an experimental group, while the control group received the ordinary instruction of the classroom. The pupils were equated upon the basis of five factors and the initial and final status of the groups were established by tests of the skills to be cultivated.

The integrative method is that type of study which attempts to bring together the results of previous investigations for the purpose of selecting the most appropriate features for immediate application. Although integrative studies may not reveal new truths, they do reveal new applications and relationships of old truths. Those who use the integrative method in constructing a curriculum make compilations of many or all available curricula and courses of study and attempt to select those elements from each which appear to be valid. In this sense the integrative method affords a quick and ready basis for establishing a curriculum when other methods take a long time. The process of integration also serves to correlate results of scattered and disorganized research activities.

Studies of the history of the curriculum supply a criterion for evaluating the work of the present and predicting that of the future. Rooney made a study of the origin of new subjects which gives an account of the reasons for their introduction into the curriculum, the struggle that was necessary before they gained acceptance and a partial evaluation of the effect the new subjects have had upon education. Studies of this type give a picture of the advance of the curriculum over a period of time.

The principal purpose of philosophical research in curriculum study is to determine the general aims of education. The problem of the determination of general aims of education is frequently confused with that of the determination of objectives. Since objectives of education are more specific and immediate, and determined by a study of social needs and pupil abilities, philosophical research is not needed in their selection. In addition to establishing general aims the philosophical method may serve to harmonize conflicting findings of objective studies. Most so-called philosophical research in the field of curriculum, however, is limited to subjective discussion of the problems of the curriculum and possesses limited value. When there is a definite problem to be solved and reflective thinking is checked by objective criteria, this method of research may make a substantial contribution to curriculum study.

TOOLS, SOURCES AND STATISTICAL DEVICES OF CURRICULUM RESEARCH

The effectiveness of research in any field is dependent upon the reliability of the information and upon the tools and devices which are employed in the collection and interpretation of data. The distribution of the principal sources, tools and statistical devices of the curriculum according to methods of research is shown in Table II. There has been a definite trend toward the use of objective measurement in recent years. In earlier investigations there was much use made of personal observation and opinion unaided by objective standards of comparison, but this subjective approach is rapidly being replaced by objective measures of information. The widespread use of statistical devices has also

contributed toward greater accuracy in description and interpretation.

From a study of Table II it may be observed that a large portion of the data of the descriptive and analytical methods is drawn from a study of textbooks and courses of study, and for analytical research periodicals also furnished a fertile source of information. In all types of research the questionnaire plays a prominent part. Tests and rating scales are often used in curriculum research. In recent studies the

TABLE II
THE TOOLS, SOURCES AND DEVICES OF CURRICULUM RESEARCH.

Sources and Tools of Research	Descriptive		Analytical		Experimental		Integrative		Historical	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Activities	8	.08	19	.12	0	0	4	.14	0	0
Courses of Study	11	.11	20	.13	3	.16	1	.03	2	.12
Observations and Interviews	34	.35	20	.13	2	.11	5	.18	4	.25
Periodicals	2	.02	30	.19	0	0	6	.21	1	.06
Questionnaires	25	.26	41	.26	2	.11	3	.11	4	.25
Rating Scales	5	.05	27	.17	2	.11	0	0	0	0
Records and Reports	17	.17	15	.10	0	0	10	.36	12	.75
Tests (Objective)	5	.05	20	.13	10	.52	0	0	0	0
Tests (Standard)	15	.15	13	.08	7	.37	0	0	0	0
Textbooks	8	.08	51	.33	5	.26	7	.25	4	.25
Statistical Devices										
Correlation	2	.02	13	.08	4	.21	0	0	1	.06
Coef. of Var.	1	.01	0	. 0	0	0	0	0	0	0
Exper. Coef.	0	0	1	.01	2	.11	0	0	0	0
IQ, MA and CA	6	.06	2	.02	5	.26	0	0	0	0
Mean	9	.09	8	.05	5	.26	0	0	0	0
Median	8	.08	12	.08	4	.21	0	0	0	0
P. E.	0	0	1	.01	3	.16	0	0	0	0
P. E. and S. E. dif.	1	.01	0	0	5	.26	0	0	0	0
Per cent	20	.21	35	.23	5	.26	4	.14	3	.19
Quartiles	3	.03	4	.03	2	.11	0	0	0	0
Range, etc.	21	.22	45	.29	3	.16	1	.03	1	.06
Rank	1	.01	14	.09	1	.05	1	.03	0	0
S. D.	2	.02	8	.05	5	.26	0	0	0	0
Totals*	96		154		19		28		16	

* These numbers indicate the frequency with which certain tools and devices were used irrespective of the number of studies.

TABLE III
THE DISTRIBUTION OF PURPOSES OF CURRICULUM INVESTIGATIONS ACCORDING TO METHODS OF RESEARCH USED.

	Descriptive	Analytical	Experimental	Integrative	Historical	Philosophical	Multiple
Objectives	7	42		7	1	29	8
Content	22	42	2	6	2	29	17
Difficulties	6	18	7			2	2
Evaluation	37	28	10	5	1	12	23
Multiple*	24	24	1	10	12	5	

* The term "multiple" indicates that two or more methods or purposes were involved in the study.

standardized test is used in the objective evaluation of pupil achievement. This is a significant tendency because the most important factor in the study of the curriculum is the development of appropriate standardized measurements of the achievement of pupils. Rating scales are means of refining and objectifying personal judgment, but like the questionnaire they should be checked for reliability and validity.

Among the statistical devices that are used in the treatment of data percentage, range and frequency distributions satisfy the needs of the majority of investigators.

THE PURPOSES OF CURRICULUM RESEARCH

The primary purposes for which curriculum research are conducted include: (1) The determination of aims and objectives; (2) the selection of subject matter; (3) the determination of difficulty of materials and their placement in grades; and (4) the evaluation of the results of administering the curriculum. In accomplishing these purposes it will be noted in Table III that all of the methods of research previously described have been used. In the determination of the general aims of education, as has already been noted, the philosophical method is very important, while in the determination of objectives the analytical method predominates. Both the analytical and philosophical methods hold a prominent position in selecting subject matter. In the determination of difficulty of materials and grade placement the most effective results are obtained by the use of experimentation. The descriptive method of which school survey is a technique is most prominent in evaluating the courses of study. As Table III indicates, in many instances several methods of research are used in attaining an objective.

CONCLUSIONS

All of the general methods of research used in education have been employed in studying curriculum problems. The earlier studies make much use of the descriptive method. In 1926 the analytical method was at its height. Analysis still holds the position of most frequent use, but there are indications that the experimental method will eventually find a prominent place in curriculum research. The philosophical, integrative, and historical methods still hold a prominent place in curriculum study.

The techniques of school surveys wherein the curriculum is described have shown a decided trend toward the measurement of the curriculum in terms of pupil performance rather than by expert opinion. The most common limitations of curriculum research include failure to use satisfactory measuring instruments and lack of control of the conditions of the study.

The most difficult problem confronting those making curricula is measurement of the outcomes of teaching. One phase of this problem involves the measurement of intangible elements which are often termed attitudes, appreciations and feelings. The measurement of skills is fairly well developed, and it is possible to measure, to some extent, the effectiveness of the curriculum in terms of understandings. There is need for the development of means for the determination of the effect of experiences upon attitudes and emotional life of the learner.

LEARNING ESSENTIALS IN AN ACTIVITY CURRICULUM*

by
L. Thomas Hopkins
Lincoln School, Teachers College, Columbia University

The problem for consideration is, "What happens to the learning of the technical processes, steps, or essentials in a curriculum of activities or experiences?" I have the responsibility of defending the thesis that the essentials are learned. To deal adequately with this problem, I must state a viewpoint on a few questions prior to the presentation of objective test evidences of achievement. I shall, therefore, center my discussion around four points:

1. What is a curriculum of activities or experiences?
2. What are the essentials in such a curriculum?
3. What standards of learning are desirable in these essentials?
4. What is the objective evidence to support the contention that the essentials are learned or that the achievement attained is satisfactory?

What is a curriculum of activities or experiences? To determine what is a curriculum of activities or experiences one must examine the two ends of a scale of curriculum practice, on one of which is located the subject curriculum and on the other the integrated experience curriculum.

The subject curriculum is characterized by a large number of subjects organized more or less independently, with subject matter selected in advance of learning by sociological procedures arranged in logical order and emphasizing primarily the learning of information and the development of skills by a relatively passive learner. There are uniform learnings for each grade, minimum standards of attainment, objective examinations, grade organizations, credits, marks, promotions, and other administrative devices. The education of the individual is selected, organized, and presented to him by the school. The control is external to the learner and the learning process. Apparently, education is conceived of as the accumulation of subject matter, skills, promotions, and credits within subjects.

The integrated curriculum, on the other hand, is organized around fundamental interests or abiding experiences of the learner. Subject matter is fixed in advance only in broad outline, is selected on the basis of immediate functioning in the learning experience, and is organized psychologically. The learner is active, since he is within the educative process seeking to develop and direct it better. Emphasis is placed upon meanings, insights, understandings, and broad techniques. Grades represent years in school. Standards of achievement from year to year are variable and related to the individual group. Objective subject-matter examinations are infrequently used, since their validity for such a curriculum is seriously questioned. The control of learning rests primarily within the group composed of teacher and pupils, all of whom are considered learners in a new situation. Education, then, becomes a process of aiding the individual to increase the area and depth of experience and direct better its subsequent development. These two extremes of educational practice rarely exist. Most schools operate at some intermediate point on the scale. The experience or activity curriculum as it is practiced is closer to the integration than the subject end. It consists primarily of a large integrated unit selected on the basis of pupil interest and sound social significance, which may occupy from 50 to 75 per cent of the school day. The remaining 50 to 25 per cent is given to other activities of a less integrated character. I have this type of curriculum in mind in discussing this problem.

* This is a summary of an address delivered at Minneapolis February 25, 1933, before the members of the Society for Curriculum Study. The test results and statistical data were compiled by Dr. James E. Mendenhall of the Research Staff, Lincoln School.

What are the essentials in such a curriculum? In order not to obscure the issue I wish to admit at the outset my belief in essentials. The pertinent points seem to be: (a) Are there essentials common to both the subject and experience curriculums? (b) Are there essentials in a subject curriculum not considered essentials in an experience curriculum, and are there essentials in an experience curriculum not considered essentials in a subject curriculum? (c) When and how are these essentials to be learned by pupils?

It seems to the writer that there are essentials common to all types of elementary school curriculums. A few most frequently accepted are that children should know how to read, write, spell, use the four fundamental processes with whole numbers, common and decimal fractions, and express their ideas in clear, direct, accurate, forceful English. In addition, subject curriculum advocates insist upon exact and specific fact or information in geography, history, and science, all of which are variable in the integrated curriculum. In like manner, advocates of the experience curriculum consider essential certain broad techniques which are variable in the subject curriculum. A few of these are that the individual (a) understand and practice desirable social relationships; (b) select for himself worth-while activities; (c) plan, execute, and evaluate the results of such activities; (d) express himself in a variety of media with a variety of tools; and (e) develop sound physical and mental health.

Furthermore, there are disagreements as to when essentials should be learned. In the subject curriculum they are usually assigned in set amounts to individual grades. In the activity curriculum they are variable from year to year. This means that any comparison of the two curriculums on common essentials should not be made by grades, but only over some longer period of time.

Finally, there is a difference also in how these essentials should be learned. In the subject curriculum they are either taught as separate subjects, or primarily as separate subjects but related to school activities or outside experience whenever possible. In the experience curriculum they may be taught (a) as separate subjects with only casual relationship to the larger integrated experience units, (b) as an outgrowth of the experience unit with separate drill periods whenever necessary to make the skill of greater functional use in the unit, and (c) as an integral part of the unit in which the need for the skill arises and is met by a new experience within the unit calling for the utilization of such skill. The results of achievement tests in the skills, which I will present later, have grown out of an experience-curriculum practice of the (b) and (c) types.

What standards of learning are desirable? The standard of learning desirable in a subject curriculum is that the individual be able to pass standardized tests of a non-functional, highly academic type, in which the learning is removed from functional experience and presented to the teacher in detached form. Most standardized tests for the measurement of the skills are constructed to measure this type of learning. In the activity curriculum the standard of learning is the ability of the individual to use the skill functionally in carrying on the larger integrated activities. At any given year level the individual should be able to read well enough to enter whole-heartedly into the unit under consideration, should write legibly enough for his immediate needs, and should spell the words used in some activity involving spelling as a functional outcome. Whether an academic test applied to functional learning is a more invalid measure than a functional test applied to academic learning is not the point at issue. I do want you to know, however, that in this study an academic test was used to measure functional learning so that you may interpret the results accordingly. Furthermore, these tests do not measure the broader techniques so essential to an experience curriculum.

What is the objective evidence showing that the essentials are learned in the experience curriculum? This evidence is based upon the achievement of pupils of the elementary division of Lincoln School of Teachers College on the old Stanford Achievement Test for the years 1925-26 to 1929-30 and on the new Stanford Achievement Test for the years 1930 to 1932 inclusive. Table I shows that in all grades Lincoln School chronological age

medians are slightly lower; mental age and intelligence quotient medians are slightly higher, and reading, arithmetic, spelling, and composite age medians are slightly higher than those for pupils in the corresponding grades in the general school population. This slightly higher achievement would probably be expected, however, because of the slightly higher intelligence of the pupils.

The data of Table I are portrayed in graphic form in Figure I. This figure shows a number of important facts. First, the median achievement age of Lincoln School pupils is slightly lower than their median mental age in grades two and three, but is distinctly higher than their mental age in grades four to seven. Second, at all grade levels their median achievement age exceeds their median chronological age by 8 to 36 months. Third, at every grade level their median achievement is considerably higher than the median achievement of pupils in the general population in the United States, as indicated by "Norm Grade Chronological Age." Fourth, grade for grade the median chronological age of Lincoln School pupils is approximately 12 months less than that of pupils in the general school population.

Table II shows the relationship between educational age and (a) chronological age, (b) mental age, and (c) norm for grade age. For every grade the achievement is superior to the chronological age, is superior in reading to the mental age in all grades except the second, is below the mental age in all except the sixth grade in arithmetic, and below the mental age in all grades in spelling. Due to the slight superiority in reading, however, the inferiority in arithmetic and spelling is overcome in the composite scores so that they compare favorably with the mental age in all grades except the second.

It is difficult to present comparative data even on objective tests as all measures are open to some criticism. With due regard for its limitations, perhaps the best single measure available for the present purpose is the accomplishment quotient. Table III shows that the mean accomplishment quotients of Lincoln School children are above 100 in all five years in reading, below 100 in arithmetic and spelling, and from 98 to 100 in composite. Since the tests are constructed with an accomplishment quotient mean of 100 for each grade, the achievement of Lincoln School children is equal to the average in the general school population. Terman,[1] however, in his study of 565 superior boys and girls with a mean intelligence quotient of 151.6, found on the Stanford Achievement Test a mean accomplishment quotient in reading of 95.66; in arithmetic of 90.51; and in spelling of 91.73. The achievement of Lincoln School pupils compare favorably with these results from this superior group.

One significant point from Table III which should not be overlooked is that the mean intelligence quotient of pupils has

TABLE I

GRAND MEDIANS, LINCOLN SCHOOL, 1925-26 to 1929-30

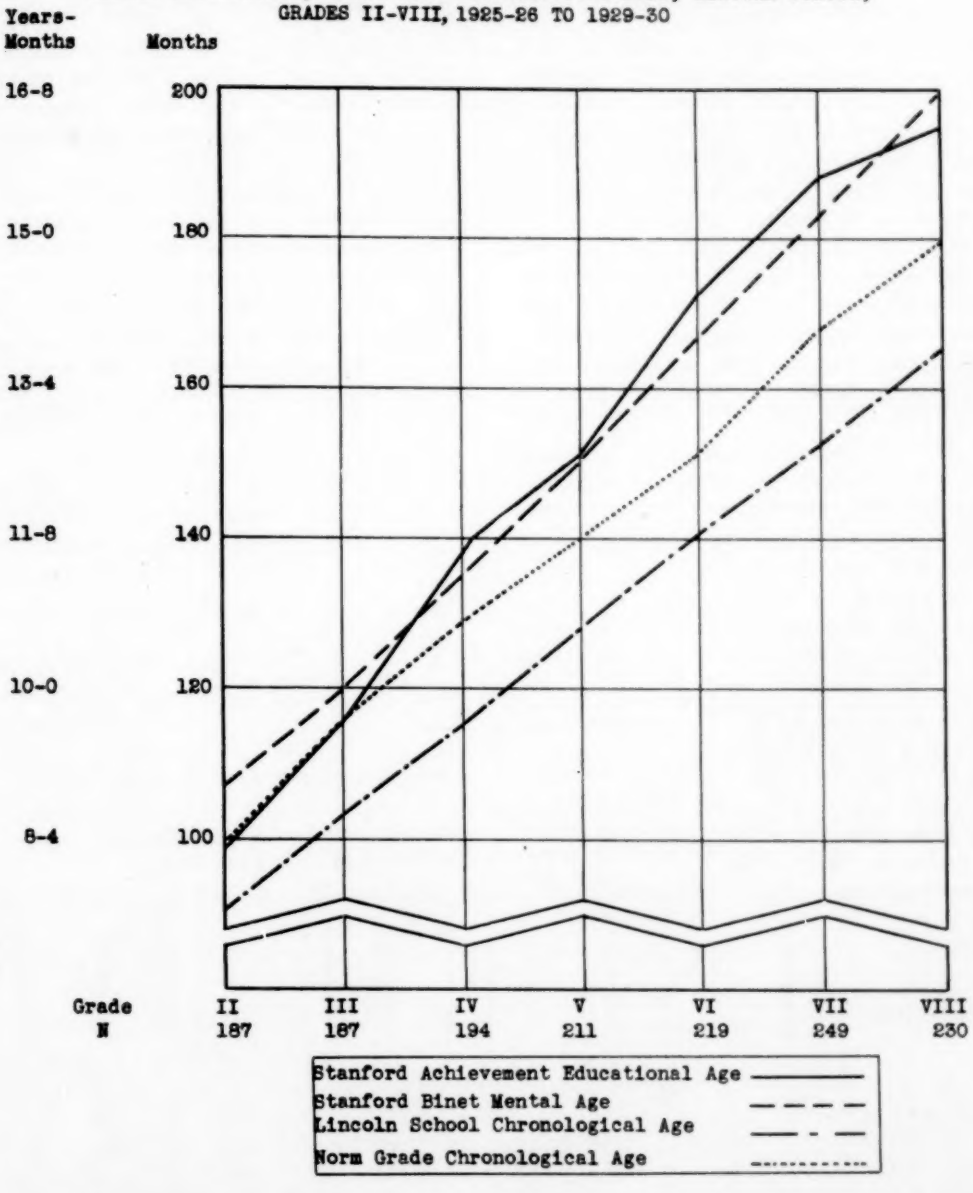
Grade	N	Chronological Age Months	Binet Mental Age Months	Binet Intelligence Quotient	Reading Age Months	Arithmetic Age Months	Spelling Age Months	Composite Age Months	Norm Grade* EA or CA Months
II	187	91	108	117	102	94	96	99	97
III	193	104	121	116	124	110	113	116	115
IV	194	115	136	118	144	130	131	138	129
V	211	128	151	118	167	143	143	151	140
VI	219	141	167	118	187	168	155	173	151
VII	249	153	183	120	199	179	174	189	163
VIII	230	165	199	120	206	193	187	195	177

* This column shows the educational age or chronological age of pupils in the corresponding grades of all schools that were used in the construction of norms for the old Stanford Achievement Tests. These ages represent the average achievement in reading, arithmetic, spelling, and composite score of pupils in Grades I-VIII in the general school population of the United States.

1. Lewis M. Terman, Genetic Studies in Genius (Stanford University, California: Stanford University Press, 1925), pp. 291-295

FIGURE I

MEDIAN EDUCATIONAL, MENTAL AND CHRONOLOGICAL AGES, LINCOLN SCHOOL, GRADES II-VIII, 1925-26 TO 1929-30



varied only slightly (+1.27 points) from 1925-26 to 1929-30, and the mean accomplishment quotients have shown little change (reading -2.10; arithmetic -3.03; spelling -1.26; composite -.47). The greatest variation occurred between 1925-26 and 1926-27, since which time there has been a variation of less than one point, a very high stability of performance.

Beginning with the school year 1929-30 the new Stanford Achievement tests have been used. Data are available for the three years ending June 1930, 1931, and 1932. In Table IV are presented the medians of the accomplishment quotients of pupils on the various sub-tests and the composites for these three years, except grade nine, which are only for the year 1930. These data seem to show for

TABLE II
DIFFERENCES BETWEEN EDUCATIONAL AGE AND CHRONOLOGICAL AGE, MENTAL AGE, AND NORM GRADE AGE

		Chronological Age				Mental Age				Norm Grade Age			
Grade	N	Read. Age-C.A. Mo.	Arith. Age-C.A. Mo.	Spell. Age-C.A. Mo.	Comp. Age-C.A. Mo.	Read. Age-M.A. Mo.	Arith. Age-M.A. Mo.	Spell. Age-M.A. Mo.	Comp. Age-M.A. Mo.	Read. Age-G.A. Mo.	Arith. Age-G.A. Mo.	Spell. Age-G.A. Mo.	Comp. Age-G.A. Mo.
II	187	11	3	5	8	-6	-14	-12	-9	5	-3	-1	2
III	193	20	6	9	12	3	-11	-8	-5	9	-5	-2	1
IV	194	29	5	16	23	8	-6	-5	2	15	1	2	9
V	211	39	15	15	23	16	-8	-8	0	27	3	3	11
VI	219	46	27	14	32	20	1	-12	6	36	17	4	22
VII	249	46	26	21	36	16	-4	-9	8	36	16	11	26
VIII	230	41	28	22	30	7	-6	-12	-4	29	16	10	18

TABLE III
MEAN ACCOMPLISHMENT QUOTIENTS ON THE STANFORD ACHIEVEMENT TEST OF LINCOLN SCHOOL CHILDREN, GRADES II TO VIII, Inclusive

Year	N	Intelligence Quotient	Accomplishment Quotients			
			Reading	Arithmetic	Spelling	Composite
1929-30	316	119.08	104.43	94.36	92.26	99.67
1928-29	288	118.40	106.79	95.16	93.94	99.28
1927-28	296	117.47	105.96	96.23	95.71	99.84
1926-27	303	117.78	104.97	94.68	94.69	98.98
1925-26	280	117.71	106.53	97.39	93.52	100.14
Total N Grand Means	1483	118.10	105.70	95.53	94.01	99.58

TABLE IV
MEDIANS OF THE ACCOMPLISHMENT QUOTIENTS OF LINCOLN SCHOOL PUPILS ON THE NEW STANFORD ACHIEVEMENT SUB-TESTS FOR THE THREE YEARS 1930, 1931 and 1932

Grade	Number of Pupils	Paragraph Meaning A.Q.	Word Meaning A.Q.	Spelling A.Q.	Language Usage A.Q.	Literature A.Q.	History and Civics A.Q.	Geography A.Q.	Physiology and Hygiene A.Q.	Reasoning A.Q.	Computation A.Q.	Composite A.Q.
II	132	93	98	83						91	80	91
III	131	100	101	92						99	92	97
IV	131	102	103	94	115	106	95	98	104	97	92	101
V	122	106	110	96	115	110	97	98	102	98	94	101
VI	134	107	112	93	112	106	95	100	100	98	96	101
VII	149	108	109	94	108	104	96	107	102	92	97	102
VIII	152	103	104	95	101	98	103	101	96	93	98	98
IX*	52	103	105	94	100	98	99	98	104	97	98	100

* These data are based only on returns for the year 1930 since the new Stanford Achievement Test was not used in 1931 and 1932.

all grades achievement greater than normal expectancy in paragraph meaning, word meaning, language usage, literature, physiology and hygiene; normal achievement in history and civics, geography, arithmetic reasoning and computation in the last four but not in the first four grades; and slightly below normal achievement in spelling. Accomplishment quotients in all sub-tests rise slightly in the intermediate grades.

The median composite accomplishment quotient is low (91) in grade two, but is satisfactory in all other grades (97-102), and particularly so after grade four, when scores on all of the sub-tests are combined. This very slight variability in the median composite accomplishment quotient for all grades compares favorably with the data from the old Stanford Achievement Test for the years 1925-26 to 1929-30 as indicated in Table III.

In conclusion, those who are familiar with statistical procedures recognize that this attempt to present only a very brief summary of findings is due to lack of time. A complete report of learning the essentials in Lincoln School will be available shortly from the Bureau of Publications, Teachers College. However, if the old and new Stanford Achievement tests are considered valid measures of some of the essentials, an assumption nearer the practice in the subject than in the experience curriculum, it seems reasonable to conclude that children in Lincoln School learn these essentials as well as children of like age, grade, and intelligence in the general school population, even though in Lincoln School such essentials are considered of relatively less importance and are given relatively less attention than in the subject curriculum.

AN ACTIVITY CURRICULUM IN A SCHOOL OF MEXICAN CHILDREN

Junius L. Meriam
University of California at Los Angeles

Some years ago a Japanese student came to the University of Missouri. He had graduated from a secondary school in Japan under the guidance of American teachers. He was admitted as a freshman. Within a few weeks it was discovered that he had insufficient command of the English language to enable him to understand the lectures and the readings assigned. His adviser brought him to me, as I was then in charge of the University High School. I was asked to place this Japanese student in two or even three classes in English. My reply was prompt: "A high-school class in English is not the place for a student of foreign tongue to learn the language. Let me place him in the seventh grade where, under my direction, that class is following a strictly activity curriculum, not at all the conventional subjects. This Japanese student will acquire control over our language if engaged in a simple study here English is constantly and insistently functioning." His later record as a university student supports this contention.

Observation in the lower grades of the schools in Southern California led the writer to feel that foreign-tongued pupils, chiefly Mexican though many Japanese, are not schooled effectively. Too much time and effort is given to the mere form of our language with insufficient ideas to be expressed in English. That is, the language presented to them is largely formal rather than functional. The pupils respond relatively little; they have little for which to respond. Similarly, these little people are put to the task of learning to read, but advancement in story content is so slow that motivation is absent and response is negative. Bits of number work and exercises in writing provoke a minimum of response; to these foreign-tongued children there is really nothing to which they can respond. And by reason of this lack of response, provision is quite generally made for a "little-B-one" grade which spends a half year or even a full year in getting ready to enter the regular first grade.

A district superintendent offered me a strictly Mexican school for my study, experimentation and demonstration. I was allowed practically full direction of curriculum work of the school, and supervision of the teachers. In September, 1930, the school enrolled about 75 pupils with three teachers. In September, 1931, a fourth teacher was added and enrollment increased to about 110 pupils. In the first year the school was organized into grades, second and first, with a "prefirst", a group regarded as so handicapped in language that one year of schooling was needed before these children were ready to pursue the regular first grade work. This same organization continued the second year, but included grades three and four, with some admissions from other schools. In the third year, September 1932 to June 1933, the "prefirst" grade was practically omitted, that is, all pupils who were six or nearly six years of age were placed at once in the first grade. Pupils in the other grades were advanced largely on the basis of age. The tabular view presented below covers only the first two years, and not this later organization.

The school is located about forty miles southeast of Los Angeles, in the township of Placentia. For miles around are orange groves, with some rather extensive walnut groves. Adjacent to this country school is a Mexican hamlet, a cluster of huts. The inhabitants are relatively stable; occasionally occupied in picking fruit and nuts in the vicinity. Many of the Mexicans in nearby regions, however, live in old Ford cars, moving them about wherever there is any work, or they pitch their tents in orange or walnut groves and move on as conditions require. Not so in this school district where relatively little migration exists. There is much unemployment and idleness. Men pitch quoits or just sit in the warm sun. Women, when

not employed with the men in picking fruit or nuts, sit in the sun or at times on the shady sides of their huts and -- quite generally -- wait for time. The children, when not in school, are easily schooled in the habits of their elders.

The houses, in the main, are mere shacks, though some are very respectable bungalows. The furnishings are most meagre. One bed may suffice for a family of six. An old trunk may be the chief or only commode. An investigation of 116 representative Mexican houses shows that in more than one half of these the total value of furniture is less than $10. The yard is almost empty. A few boards on end may constitute an outdoor toilet. Part of a shed may be a sun shelter for a dog or goat; sometimes a few chickens; perhaps it appears to conceal a pile of rubbish, if the people be thrifty enough to assemble such from the otherwise barren yard of sand. In a few yards some flowers grow -- largely of their own accord rather than by the care of the family who lives there. A cactus plant here and there -- a crude sort of garden -- supplies a little food when made into salad or greens.

This particular sordid hamlet (some others are better, some not so good) presents a very real challenge to those in charge of nearby schools, in case the school people have any concern over these Mexican children, their homes and environment. Complacency with the three R's is not possible if our school people care for these children further than to "keep school" so long as the state law insists upon their attendance. The earnest student of education is led to ask most seriously: What should the school attempt for these children brought into this environment without their consent? The traditional school operates on the principle that each grade is a preparatory step to the next higher, but seldom does a Mexican pupil complete the elementary grades.

A survey covering ten elementary school districts, approximately two hundred twenty-five square miles of territory in San Bernardino County, California, reveals the following distribution of Mexican pupils by grades:[1]

Grade	Per cent of Total Enrollment
1	46.58
2	15.53
3	12.72
4	10.10
5	8.79
6	3.08
7	2.33
8	.84

Seldom does a Mexican pupil enter high school. Only on the obsolete principle of general discipline or because of complacency with the traditional school is there reason for giving these unaspiring Mexican children the schooling given to American children, most of whom now enter the secondary school.

Free from all the conventions of the traditional school with its curriculum of "readin', 'ritin', 'rithmetic"; free to do what one's conscience dictates as the most serviceable schooling possible for these brown-skinned foreign-tongued children; what would an earnest school man and his teachers attempt?

Briefly stated, the curriculum program used in this experiment during the two years, 1930-1932, was as follows:

Time	Play	Stories	Handwork
9-10 A. M.	I	III	II
11-12 A. M.	II	I	III
12- 1 P. M.	III	II	I

Thus each grade had a full 60-minute period in each of the three subjects, or inclusive "activities." Certain irregularities in the above schedule were occasioned by the "prefirsts" referred to earlier in this article, and to some fourth-grade transfers from other schools in the second year and temporarily scheduled with grade III. The above three-three schedule, however, was very closely followed.

The school is strictly departmentalized on the basis of the three "activities." Miss C is play-teacher, located in a room so equipped as to provide for the playing of games. Mrs. P has her own story room, equipped for the enjoyment of stories. Mrs. S has her workroom, equipped for the employment of busy little hands. At the close of each hour, the pupils exchange rooms.

1. M. E. Hill, The Development of an Americanization Program. (Published by the Board of Trustees of Chaffey Union High School and the Chaffey Junior College, 1928) p. 51.

The hour, 10:00 to 11:00, is omitted from the above schedule. It is occupied by three other "activities", for each of which each group has twenty minutes: 1) song, 2) folk dance and 3) playground. This three-in-one hour schedule admits of easy adjustment to varying needs. All girls or a selected group may join in song. Certain folk dances may call for pupils selected from two or three grades. The playground is readily the activity for pupils not occupied elsewhere.

The details of this activity curriculum invite a lengthy story as to the nature of content and manner of procedure; a minute description of the rooms with their special equipment; a searching inquiry into the values and the difficulties involved.

The reader of this article probably joins other students and laymen, who have their attention called to this school, in asking quite prematurely: How do these pupils learn to read, write and cipher? How do they meet the standards of achievements in the conventional school subjects? Frankly, and in the interests of these little foreign-tongued children, such questions are quite inappropriate. But out of respect for those who are committed to the "old" school with its abstractions from real life, and are not yet willing to "tune in" with child life in a curriculum of life acts, a table is here presented to indicate, tentatively, the achievements of these pupils in reading, writing and arithmetic, as compared with the norms in schools of our American children.

It is to be readily recognized that these figures mean but little when only 80 pupils are involved. This is only a preliminary report. It is the hope and expectation of the writer to continue this experiment several years, but this small array of data in Table I is indicative.[1]

The Detroit Reading Tests were used; Word Recognition test for the first grade; Test I, Form A for the second grade; Test II, Form A for the third grade.

The Ayres Handwriting Scale was applied to the writings of each pupil taken from his regular school work nearest the two dates given in the table.

The New Stanford Arithmetic Tests, Form W, were used for all the grades except in grade I, where no test in arithmetic was given.

All the tests, scorings, and calculations were under the direction of Professor J. H. Williams, who has charge of courses in tests and measurements at the University of California at Los Angeles.

A few generalizations may be made from the data in this table:

1. In general, the data indicate a highly satisfactory achievement by these pupils, in terms of the three R's. It must be borne in mind by the reader that the objective in this school is positively not achievement in the traditional three R's, but in the three activities:

Play -- for wholesome fun
Stories -- for a higher type of leisure
Handwork -- constructions, useful, and ornamental.

Achievement in the formal three R's as measured by standardized tests is, therefore, a strictly incidental by-product. These tests were given as the only measures now available and serve as a tentative means of checking with standards accepted in public schools. To measure achievement in the real objectives in this experiment is quite another issue.

2. Figures indicate that these pupils have a low "intelligence." The range is from 56 to 137, with nearly two thirds of these pupils below 100. Someone has said: "Intelligence is that which intelligence tests test." The intelligence shown by these pupils in designing, constructing, and flying kites; in constructing from waste material a variety of articles useful in their simple homes; in delicate and artistic needlework is not measured. These pupils are placed at a disadvantage when they are narrowly compared with their American competitors. The data in the following table is, therefore, more to their credit than appears on the surface.

3. Figures indicate that these foreign-tongued children are close to the norm in

1. The data here is in accord with data of similar studies:
E. Collings, An Experiment with a Project Curriculum, pp. 225-283
Lincoln School, Curriculum Making in an Elementary School, pp. 270-305
J. L. Meriam, Child Life and the Curriculum, pp. 441-479
Journal of Educational Sociology, Vol. 2, pp. 75-82
Journal of Educational Psychology, Vol. 6, pp. 361-364

American schools in the three R's. Yet more to their credit is the progress in months, as seen in the column at the right. Advancement in reading seems easily explained. How different from the usual school. During one full hour every day the whole group enjoys stories under the guidance of a teacher whose great problem is to help little people enjoy stories. She tells stories; soon the little people have their own stories to tell. All listen, of course, if the stories are good, and plenty of good stories are available. They dramatize stories. These Mexicans enjoy this communication through dramatization. Soon these children are reading. They read silently as individuals.

TABLE I
LA JOLLA SCHOOL

Grade Progress from October 1931 to June 1932

Grades I.Q.* Data	"Three-R's" and dates of tests	Grade Placement		Pupils		Progress in Months
		Norm	La Jolla	At or above Norm	Below Norm	
Grade I	Reading					
	Oct. 26	1.1	1.0-	5	12	
56-118	June 10	1.9	2.6	22	2	16 in 8
Mean 86.7	Writing					
19-100-4	Oct. 9		22**			
	Apr. 25		28**			
Grade II	Reading					
	Oct. 26	2.1	1.1	12	7	
58-137	June 10	2.9	2.2	0	22	11 in 8
Mean 91.9	Writing					
13-100-7	Oct. 9	35**	35**	8	14	
	Apr. 25	38**	38**	11	11	6 in 6
	Arith.					
	Oct. 26					
	June 10	2.9	2.9	13	9	
Grade III	Reading					
	Oct. 26	3.1	2.4	1	10	
60-123	June 10	3.9	3.4	2	12	10 in 8
Mean 98.2	Writing					
6-100-10	Oct. 9					
	Apr. 25	42**	4.1**	7	10	
	Arith.					
	Oct. 26	3.1	2.8	3	9	
	June 10	3.9	3.8	5	9	10 in 8
Grade IV	Reading					
	(Not					
71-118	given)					
Mean 92.9	Writing					
13-100-8	Oct.					
	Apr. 25	46**	40**	5	12	
	Arith.					
	Apr. 5	4.7	3.6	1	14	
	June 10	4.9	4.4	5	15	8 in 2

* The I.Q. data in this column are from the Goodenough test. This column may be read: Grade I has a range of I.Q. from 56 to 118; the mean is 86.7. Of 23 pupils in this grade, 19 are below 100 I.Q., and 4 are above.

** This number is the score in the Ayres Handwriting Scale. The norm score at the close of each grade is, respectively, I (none), II 38, III 42, IV 46.

They read aloud in groups. But they are never called upon to read to the teacher to show her how well they can read. Books go home, not as assigned "homework" but by individual choice to enjoy the story. All this is possible if a well selected library supplants the usual "readers."

Various other aspects of this experiment will be presented in other articles. Mr. Glenn Riddlebarger, District Superintendent for Placentia, California, has an article in the Sierra Educational News, for June 1931, in which he expresses his reaction to this activity program from the viewpoint of a superintendent. Supervisors and teachers, as well as pupils, have groaned over the difficulties for foreign-tongued children in American schools. This experiment goes far in avoiding all those difficulties by the use of an activity curriculum framed for immediate service to these children in home and community life.

LEARNING THE FUNDAMENTALS IN THE ACTIVITY CURRICULUM

Ellsworth Collings
University of Oklahoma

Every school, whether traditional or progressive, is founded upon some kind of a philosophy of education. Many people do not realize this fact. As the writer sees it, the philosophy of education guiding the school is as follows:

First, the writer believes boys and girls are active beings. Observation of boys and girls in school, home, or community reveals this fact. They are active in multitudinous ways. There is nothing peculiar in this dynamic nature of boys and girls. Activity of some kind is common to all biological life. Lowell observed this fact when he said "Whether we look or whether we listen, we hear life murmur, or see it glisten." It may be the songs of the birds, the joyous notes of the insects, or the glories of the fields. These manifold activities on all sides of us are the manifestations of the urge to grow, working themselves out into the wonderful creations of life about us. It is Life itself. Boys and girls are no exception. They are rather a beautiful illustration of the active life on all sides of us. This fact means much. The work of the school must be planned in terms of the activities of boys and girls if it is to provide opportunity for them to live and grow the life way.

Second, the writer believes boys and girls learn, develop, grow in and through the pursuit of their own activities. Study of the purposeful activities of children reveals they include a definite end - a purpose - and the means necessary for successful achievement. For example, in the study of "How America Became a Nation", the purpose is to find out how our country became a nation. They want to know something specific and definite. In this sense, the boys and girls have a definite end-in-view; they have a purpose. The means in this illustration include the necessary materials for finding out how America became a Nation. They include, first, information dealing with the discovery and settlement of America, the natural resources of this country, the sociological and economic conditions of this country and other countries, the struggle for Independence, the colonial governments and governments of other countries, and the formation of the Union. In the second place, the means include reading, spelling, writing and English. The means in this instance include subject matter found in the conventional school subjects.

One further point should be observed in the analysis of the means of purposeful activity. The conventional school subjects are not utilized as such in purposeful activity. The subject matter of these subjects receives attention only when it contributes genuinely to a more effective realization of the purposeful activity of boys and girls at the time. The use of historical information in finding out how our nation originated; the use of information in political science in finding out how our government was formed; the use of sociological information in finding out the customs and traditions of our people and people of other countries involved; the use of economic information in finding out the systems of taxation, transportation, and commerce affecting the frontier of our country; the use of geographical information in understanding the location of our country, and its natural resources; the use of reading in studying books and records; and the use of English in making written records of investigation and discussing the findings of study are typical illustrations of the use of subject matter found in the conventional school subjects by children in realizing more fruitfully their activities. Subject matter used in this fashion plays a very genuine part in the realization of the purposeful activities of boys and girls, and, as such, is of appreciative and immediate value to them. It constitutes, in this sense, the real means of purposeful activity.

The means in the illustration of "How America Became a Nation" include subject matter found in several of the conventional school subjects. The discovery and settlement of America and the struggle for Independence are usually thought of as parts of the subject called history; the customs and traditions of people in settling America are usually labelled topics in sociology; systems of taxation, transportation, and commerce are listed in the subject of economics; types of government and governments of other countries are found in the subject of political science; the natural resources and location of countries are divisions in the subject of geography; making written records of investigations and oral expression used in discussing findings of investigations are parts of the subject of English; and the study of books, records and other sources is labelled reading. In brief, the means necessary in studying "How America Became A Nation" involves simultaneous use of subject matter of history, sociology, economics, political science, geography, English, and reading. This is true in every instance of purposeful activity of boys and girls. Purposeful activity, in this sense, cuts across several conventional school subjects. It utilizes subject matter from several conventional schools at the time it is under way.

There are two opposing views concerning learning fundamentals in the activities of children. One view holds that fundamentals involve finding, selecting, and using the means necessary for successful pursuit of the chosen activities of children. This view would have boys and girls make a study of possible materials needed, select the most desirable materials available, and use the materials in the most intelligent way in execution of the activity under way. This view holds that materials are a means in successful performance of the activity. The other view holds that fundamentals include certain portions of the traditional school subjects. This view would utilize the activities of boys and girls as means for teaching the desired portions of the traditional school subjects. Personally, the writer accepts the first view.

It seems to the writer that learning how to find, select, and use the means (materials) needed to carry forward successfully chosen activities is fundamental learning. Certainly we will agree that such learning is fundamental in life outside the school. Success in life depends very largely upon this ability. And this ability is developed in and through boys and girls finding, selecting, and using the means (materials), with the aid of the teacher, needed for successful pursuit of the activities at the time they are under way.

The question is often raised regarding the extent that children learn the fundamentals of the conventional school subjects in the activity schools. The conventional school subjects are considered the fundamentals of the traditional school. Mr. Andrew Parker attempted to answer this question for the University of Oklahoma Junior High School in his master's thesis entitled "A Comparative Study of the Achievement of the University Junior High School." The achievement of the University Junior High School (Activity School) was compared with the achievement of the Pauls Valley Junior High School (Subject School). Following is a summary of Mr. Parker's study.

I. FUNCTIONS MEASURED

Fourteen scores were secured for each pupil except those in the seventh grade for whom the tests in General Science were not given because they were made up for grade eight and above. The pupils were measured in the following subjects:

1. Reading
2. Health
3. General Science
4. Civics
5. Addition of Fractions and Mixed Numbers
6. Subtraction of Fractions and Mixed Numbers
7. Multiplication of Fractions and Mixed Numbers
8. Division of Fractions and Mixed Numbers
9. Addition, Subtraction, and Multiplication of Decimals
10. Division of Decimals
11. Composition
12. Writing Quality
13. Writing Speed
14. Spelling

The scores found in this study are not scores made by the individual pupils, but

the arithmetic mean, or the average score for each subject in each grade is used.

II. TESTS AND SCALES USED

Kuhlman-Anderson Intelligence Tests were used in measuring the intelligence of the pupils in each school for the purpose of matching each pupil in the smaller school, the University Junior High School, with one of approximately equal mental ability from the larger school, the Pauls Valley Junior High School.

Tests and Scales for measuring the achievements or efficiency of the pupils in the common facts and skills are as follows:

1. Kelley - Ruch and Terman: Stanford Achievement Test, Reading Examination; Form A for grades two to eight
2. Ruch - Popenoe: General Science Test, Form B for grades eight and nine
3. Gates - Strang: Health Knowledge Test, Form I
4. Brown - Woody: Civic Test, Form B grades seven to twelve
5. Ruch - Knight - Greene and Studebaker: Compass Diagnostic Tests in Arithmetic; Test V; Addition of Fractions and Mixed Numbers; Form A
6. Ruch - Knight - Greene and Studebaker: Compass Diagnostic Tests in Arithmetic; Test VI; Subtraction of Fractions and Mixed Numbers; Form A
7. Ruch - Knight - Greene and Studebaker: Compass Diagnostic Tests in Arithmetic; Test VII; Multiplication of Fractions and Mixed Numbers; Form A
8. Ruch - Knight - Greene and Studebaker: Compass Diagnostic Tests in Arithmetic; Test VIII; Division of Fractions and Mixed Numbers; Form A
9. Ruch - Knight - Greene and Studebaker: Compass Diagnostic Tests in Arithmetic; Test IX; Addition, Subtraction, and Multiplication of Decimals; Form A
10. Ruch - Knight - Greene - Studebaker: Compass Diagnostic Tests in Arithmetic; Test X; Division of Decimals; Form A
11. Hudelson: English Composition Scale. First Revision
12. Ayers: Handwriting Scale, For Measuring the Quality and Speed of Handwriting
13. Morrison - McCall: Spelling Scale

III. PUPILS MEASURED

There were sixty-four pupils enrolled in the University Junior High School, and two hundred fifteen pupils enrolled in the Pauls Valley Junior High School. Sixty-four of these were selected for the achievement tests on the basis of their similarity to those of the University Junior High School in intelligence.

Table I gives a list of the pupils in each school. The first column on the left gives the initials of the pupils of the University Junior High School and the second column gives the intelligence quotient. The third column gives the initials of the pupils in the Pauls Valley Junior High School, and the fourth column gives the intelligence quotient. It will be observed that the pupils in these schools are matched on the basis of approximate mental ability.

TABLE I

A COMPARISON OF THE INTELLIGENCE SCORES OF THE PUPILS OF THE UNIVERSITY JUNIOR HIGH SCHOOL WITH THE PUPILS OF THE PAULS VALLEY JUNIOR HIGH SCHOOL

SEVENTH GRADE

UNIVERSITY JUNIOR HIGH SCHOOL			PAULS VALLEY JUNIOR HIGH SCHOOL		
No.		I.Q.	No.		I.Q.
1	P.B.	80	1	C.P	81
2	M.B.	97	2	L.L.	97
3	L.C.	109	3	V.L.	109
4	J.C.	114	4	D.S.	115
5	R.C.	121	5	B.G	121
6	A.D.	101	6	C.O.H.	101
7	P.D.	121	7	B.T.	120
8	J.E.	123	8	M.A.M.	122
9	L.G.	91	9	W.L.M.	91
10	B.G.	101	10	J.E.	101
11	I.G.	92	11	C.L.	92
12	G.H.	107	12	G.R.	107
13	H.H.	95	13	W.M.	95
14	R.L.	114	14	J.C.	114
15	M.M.	108	15	J.R.R.	108
16	E.M.	86	16	B.M.	86
17	E.R.	106	17	R.S.	106
18	C.S.	105	18	I.B.	105
19	J.S.	103	19	M.S.	103
20	I.S.	104	20	P.G.	104
21	H.M.W.	123	21	D.R.	122
Arithmetic Mean		104.7	Arithmetic Mean		104.7

EIGHTH GRADE					
No.		I.Q.	No.		I.Q.
1	S.J.A.	125	1	D.K.	126
2	H.A.	105	2	M.L.	106
3	D.A.	103	3	K.C.	103
4	N.A.	124	4	L.C.	124
5	R.B.	116	5	M.L.G.	114
6	M.B.	110	6	H.P.	110
7	E.C.	96	7	M.K.	96
8	S.C.	122	8	M.I.P.	122
9	M.E.C.	95	9	P.W.	95
10	M.D.	108	10	V.G.W.	108
11	L.D.	113	11	O.W.	113
12	N.H.	116	12	J.K.	114
13	G.H.	98	13	R.S.	98
14	Y.J.	109	14	J.C.	109
15	J.M.	92	15	F.S.	92
16	J.P.	106	16	I.G.	106
17	E.P.	94	17	H.M.	93
18	F.S.	99	18	L.C.A.	101
19	B.S.	128	19	B.J.C.	130
20	G.T.	95	20	A.B.V.	95
21	B.U.	95	21	M.R.H.	95
22	B.W.	112	22	H.R.	112
Mean		107.3	Mean		107.3
NINTH GRADE					
1	F.A.	151	1	P.G.	150
2	B.A.	112	2	R.H.	112
3	H.B.	94	3	E.R.	94
4	M.N.B.	122	4	C.T.	124
5	J.B.	113	5	E.B.	116
6	S.C.	118	6	F.D.	118
7	F.D.	135	7	M.P.	132
8	G.E.	133	8	M.S.	130
9	R.H.	110	9	B.C.	110
10	L.L.H.	98	10	M.A.H.	98
11	F.H.	139	11	A.B.H.	140
12	W.N.L.	91	12	A.M.W.	91
13	L.L.	92	13	E.F.	92
14	P.M.	106	14	E.D.	109
15	S.P.	121	15	C.H.	124
16	M.P.	108	16	L.H.	108
17	M.R.	86	17	M.S.	89
18	K.S.	107	18	H.C.	107
19	L.S.	97	19	K.L.H.	97
20	N.S.	114	20	T.R.	115
21	R.W.	104	21	L.A.D.	104
Mean		111.9	Mean		112.3

IV. APPROXIMATELY EQUIVALENT FACTORS

1. The pupils of the two schools have approximately the same mental ability. The average intelligence scores for pupils of the seventh, eighth, and ninth grades of the University Junior High School are one hundred four and eight tenths, one hundred seven and three tenths, and one hundred eleven and nine tenths respectively. The average intelligence scores for the pupils of the Pauls Valley Junior High School used for this study, for these grades are one hundred four and seven tenths, one hundred seven and four tenths, and one hundred twelve and three tenths respectively.
2. The average chronological ages of the boys and girls of the two schools are approximately the same.
3. The number of years in school in the two schools is approximately the same. There are in each grade in each school some few retarded pupils and some accelerated pupils.
4. The length of school terms in the two schools is nine months for each school.
5. Each of the two schools has adequate library facilities. The University Junior High School is more adequately equipped for outdoor exercises such as games and sports than is the Pauls Valley Junior High School, while for indoor games the Pauls Valley School has quite an advantage in having a very good gymnasium fairly well equipped within the high-school building. The equipment for the other departments is practically the same for the two schools.
6. The teachers in the two schools are about equally well prepared for their work. Only well-prepared, experienced teachers who have proved themselves capable in other schools are to be found in these two schools.
7. The supervision of teachers and their work is quite well done in both schools. The University school is closely supervised because of the necessity of close supervision for the type of school. The Pauls Valley High School is as well supervised for the type of school maintained as is the University High School.

V. VARIABLE FACTOR

The one significant variable factor in these schools is the curriculum. The curriculum of the Pauls Valley Junior High School is the traditional subject curriculum, with emphasis upon English, mathematics, and

history. The University Junior High School curriculum is quite different. It is selected directly from the purposes of boys and girls and is under continucus construction through the cooperative efforts of supervisors, teachers and pupils of this school. No use is made of existing courses of study.

The program of studies of the University Junior High School represents five types of projects, namely:

1. The Excursion Project
2. The Communication Project
3. The Construction Project
4. The Play Project
5. The Skill Project

VI. RESULTS OF THE STUDY

The results of this study are presented in the three tables following. These tables show each grade of the University Junior High School compared with the corresponding grade of the Pauls Valley Junior High School. They indicate the following facts: First, the average mean score of each school for all functions measured; and second, the difference between the mean scores of the two schools in each function measured. The symbols used in the tables are: (U) University Junior High School mean scores; (P) Pauls Valley Junior High School mean scores; (U-P) difference between the mean scores of the two schools; a plus symbol favors University Junior High School; and minus favors Pauls Valley Junior High School.

TABLE II
COMPARISON OF THE MEAN SCORES FOR THE SEVENTH GRADE OF UNIVERSITY JUNIOR HIGH SCHOOL WITH THAT OF THE PAULS VALLEY JUNIOR HIGH SCHOOL FOR THE YEAR 1930-31

SUBJECT	(U)	(P)	(U-P)
Reading	197.0	173.0	+24.0
Health	51.8	47.7	+4.1
Civics	66.0	63.0	+3.0
Addition of Fractions and Mixed Numbers	125.0	124.0	+1.0
Subtraction of Fractions and Mixed Numbers	124.0	105.0	+19.0
Multiplication of Fractions and Mixed Numbers	91.5	87.6	+3.9
Division of Fractions and Mixed Numbers	136.0	113.5	+22.5
Addition, Subtraction, and Multiplication of Decimals	119.0	111.7	+7.3
Division of Decimals	28.0	31.7	-3.7
Composition	5.3	3.9	+1.4
Writing Quality	42.0	42.3	-.3
Writing Speed	66.7	76.3	-8.6
Spelling	70.0	80.6	-10.6
Average Mean Score	86.2	81.5	

Summary of Achievement: The average mean score of the seventh grade is 86.2 for the University Junior High School and 81.5 for the Pauls Valley Junior High School. This indicates that the Achievement of the University Junior High School is greater than that of the Pauls Valley Junior High School for the seventh grade. Out of thirteen subject differences in mean scores for this grade, nine favor the University Junior High School and four favor the Pauls Valley Junior High School. This indicates that the University Junior High School excels the Pauls Valley Junior High School in more subjects in this grade.

VII. FINDINGS OF THE STUDY

This study indicates that boys and girls of the University Junior High School do as well or better than the boys and girls of the Pauls Valley Junior High School in the conventional school subjects It should be understood that the University Junior High School is not concerned primarily in having its boys and girls rank high in the conventional school subjects. This school is concerned only when the materials of these subjects contribute genuinely to a better realization of the activities of children at the time they are under way. Unless the materials of these subjects perform this function, this school considers study of the materials of these subjects a waste of time. The only significance of Mr. Parker's study is that boys and girls do learn some of the materials included in the conventional schools in working out their activities as well or better than boys and girls who study these materials as such in the conventional schools.

TABLE III
COMPARISON OF THE MEAN SCORES FOR THE EIGHTH GRADE OF THE UNIVERSITY JUNIOR HIGH SCHOOL WITH THAT OF THE PAULS VALLEY JUNIOR HIGH SCHOOL FOR THE YEAR 1930-31

SUBJECT	(U)	(P)	(U-P)
Reading	197.0	200.0	-3.0
General Science	17.6	18.0	-.4
Health	54.2	52.0	+2.2
Civics	85.1	81.0	+4.1
Addition of Fractions and Mixed Numbers	170.0	160.0	+10.0
Subtraction of Fractions and Mixed Numbers	154.0	143.0	+11.0
Multiplication of Fractions and Mixed Numbers	128.0	124.0	+4.0
Division of Fractions and Mixed Numbers	163.0	132.0	+31.0
Addition, Subtraction, and Multiplication of Decimals	149.0	141.5	+7.5
Division of Decimals	73.0	65.8	+7.2
Composition	5.3	4.9	+.4
Writing Quality	58.5	58.2	+.3
Writing Speed	81.6	76.2	+5.4
Spelling	84.8	89.6	-4.8
Average Mean Score	100.1	96.1	

Summary of Achievement: The average mean score of the eighth grade is 100.1 for the University Junior High School and 96.1 for the Pauls Valley Junior High School. This indicates that the achievement of the University Junior High School is greater than that of the Pauls Valley Junior High School for the eighth grade. Out of fourteen subject differences in means scores for the eighth grade, eleven favor the University Junior High School and three favor the Pauls Valley Junior High School. This indicates that the University Junior High School excels in more subjects than the Pauls Valley Junior High School for this grade.

TABLE IV
COMPARISON OF THE MEAN SCORES FOR THE NINTH GRADE OF THE UNIVERSITY JUNIOR HIGH SCHOOL WITH THAT OF THE PAULS VALLEY JUNIOR HIGH SCHOOL FOR THE YEAR 1930-31

SUBJECT	(U)	(P)	(U-P)
Reading	218.0	211.0	7.0
General Science	22.6	19.8	2.8
Health	55.5	53.1	2.4
Civics	91.8	91.1	.7
Addition of Fractions	188.0	178.0	10.0
Subtraction of Fractions	165.0	157.0	8.0
Multiplication of Fractions	122.8	114.0	8.8
Division of Fractions	160.5	155.0	10.5
Addition, Subtraction, and Multiplication of Decimals	154.0	151.9	2.1
Division of Decimals	86.4	68.6	17.8
Composition	5.6	5.5	.1
Writing Quality	60.9	57.0	3.9
Writing Speed	77.0	76.0	1.0
Spelling	93.8	88.5	5.3
Average Mean Score	107.7	101.8	

Summary of Achievement: The average mean score of the ninth grade is 107.7 for the University Junior High School and 101.8 for the Pauls Valley Junior High School. This indicates that the achievement of the University Junior High School is greater than that of the Pauls Valley Junior High School for the ninth grade. Out of fourteen subject differences, all favor the University Junior High School. This indicates that the University Junior High School excels the Pauls Valley Junior High School in more subjects in this grade.

MEASURING THE SKILLS IN AN INTEGRATED PROGRAM

by
Etta Howell
Principal Roosevelt School

Maude Wilson Dunn and Dora Stoker
Long Beach Public Schools, California

BACKGROUND OF THE STUDY

Since 1930, when the Roosevelt Elementary Demonstration School of Long Beach, California, began experimentation with the integration of learning, one problem of vital concern to parents, teachers, and administrators has been that of developing skills in those subjects which have been considered the fundamentals in the traditional school. At the outset it was recognized that not all the skills which are commonly agreed to be the heritage of the elementary pupil could be attained by organizing instruction into major units of work. Accordingly, separate periods were set aside for the drill phases of arithmetic, spelling, and writing; however, the time allotted to this work was materially reduced from that of time schedules previously used. Approximately one hour of the school day was devoted to drill unrelated to the major interest, as is indicated in the following program typical of those used in grades 4, 5, and 6:

9:00 - 10:30	Major unit of work
10:30 - 11:00	Recess and physical education
11:00 - 12:10	Drill growing out of the unit
	Noon
1:00 - 2:00	Appreciations
2:00 - 2:10	Recess
2:10 - 3:10	Drill not related to the unit

Such a program was considered to be flexible, and while it gave balance to a week's work it was not strictly adhered to from day to day. There were times when an excursion, experimental activities, or construction activities occupied the entire morning. At other times attention was centered upon drill growing out of the unit of work; such was the case when the children mastered linear measure in order to plot the school grounds for their Olympic meet; when, after making a radio, they engaged in map study to locate the radio stations broadcasting the programs they were enjoying, and then delved into the intricacies of standard time belt maps to understand the hours of programs indicated in E.S.T.

In an atmosphere of freedom and unrestrained by definite time allotments for specified subjects, the teachers have carried on the experiment for three years, with an ever increasing confidence in integrated work. The following factors should be noted as conditioning the progress. For all teachers it was the first experience in this type of work. Although they were outstanding in ability, especially selected to demonstrate, most of them were subject specialists especially skillful in their own field but accustomed to the departmental point of view with its emphasis upon subject matter rather than the all-around development of each child. When they assumed the responsibility of integrating the child's experiences, these teachers obviously undertook to teach in fields unfamiliar to them.

Teachers of the special subjects, i.e., music, rhythm, industrial and fine arts, who had previously taught on a weekly schedule with a course of study, adjusted themselves to a new situation and saw their special fields in relation to the child's broader fields of experience. They taught in all grades on call whenever there was an opportunity to enrich the work by giving experience in these fields. Whether such work was initiated by the classroom teacher or by the special teacher was immaterial, for frequent conferences made it a cooperative enterprise.

The experiment was conducted under ordinary public school conditions; the

class groups were large, averaging forty-two in enrollment, and there was no additional expenditure for supplies or equipment.

MEASUREMENT OF AN INTEGRATED PROGRAM

As we ventured far from prescribed courses of study and developed new units of work replete with genuine pupil interest, we could see evidence of desirable pupil growth in attitudes, habits, and appreciations. There was no doubt that keen enthusiasm over the adventure was focusing our attention upon these values. Were we at the same time keeping the skills up to a satisfactory standard? No adequate measures of the abilities gained in the new type of work were available since standardized types are based upon facts related to separate subjects alone. In an integrated program we were attempting to break down the teaching and testing of separate subjects. It was felt, however, that a battery of tests might give some indication of general progress and for this purpose the New Stanford Achievement Tests were selected. During each of the school years 1930-1931 and 1931-1932, one form of the tests was given in the fall and another in the spring after the pupils had had seven months of integrated work. In the tabulation of results we have included only the scores of pupils who were in the school during the entire period of experimentation for the year reported.

FINDINGS OF THE TESTS

Form W of the New Stanford Achievement Tests was given in the fall of 1930 to 247 pupils in grades 3B through 6B. Table I gives the number of pupils in each grade, the standard for each grade and the class medians for the educational age and for the various subjects in this test. When the educational ages for each grade are compared with their standards, it will be seen that every class reaches the standard except the 6Byz, which is about three months below. It will be noted, however, that in some of the grades the median performances of pupils in certain subjects are below standard, e.g., dictation is below in 3Byz, 5Byz, 5A, and 6Byz, and history is below in grades 4B through 6B, a condition which may be attributable to the wide variance between the units of work in the course of study and the material in the test. On the other hand, reading is considerably above standard in all grades except 3Byz and 6Byz; language is well above in grades 4B, 4A, 5Byz, and 5Bxy, 5A, and 6Bxy; and arithmetic computation is considerably above in all grades except 5Bxy, 5Byz, and 5A. (Some computations in the test are taught in grades above these.)

In May, 1931, Form X was given to the same pupils. As indicated in Table II the educational age is at standard or above in all grades except 5Ayz and 6Ayz which are practically at standard. The outstanding fact in this table is the great growth in arithmetic computation for grades 3Ayz, 4B, 5Axy and 5Ayz, 6B, 6Axy, and 6Ayz. Considerable progress is noticeable also in language in grades 4A, 5B, 5Axy, and 6B.

In the fall of the second year of the experiment, October, 1931, Form Y of the test was given to the same grades, 3B through 6B. Again, as indicated in Table III, the grades reach standard or better in educational age, except in grades 3Byz and 3A which are practically at standard. Dictation is below standard in the yz classes and also in 3A and 5B. Again, however, ability in language and arithmetic computation stands out.

Form Z was given in May 1932. Table IV shows all grades at the educational standard or above except 3Ayz. Even the 6Ayz group (the 5Ayz of the preceding year) have brought themselves up to standard. Furthermore, there is growth in all subjects except in language in 5B and 5Ayz, literature in 5Ayz, and history in 6Ayz. Outstanding progress in arithmetic computation is noted in the fifth and sixth grades for both xy and yz groups.

CONCLUSION

The inference drawn from the test data over a two-year period is that the skills can be maintained in an integrated program when an hour a day is alloted to those skills not growing out of the units of work. An exception perhaps is spelling (dictation); but the question raised here is: Did the Stanford Achievement Test really measure the

pupils' ability to spell the words they were using? Likewise in history, though this were not a subject set aside for drill, the question can very properly be asked: Did the test measure accurately the achievement of the pupils when the units of work in the course of study related to functional social materials?

As already pointed out this battery does not measure the additional growth in attitudes, habits, and appreciations which an integrated program of studies makes possible. In conclusion when the educational ages as measured by the Stanford Achievement Tests are considered, it will be seen that all classes, even the slow moving groups, were up to standard or nearly so. Thus in an integrated program it is possible to accomplish satisfactory results in the fundamental skills.

TABLE I
STANDARDS, EDUCATIONAL AGES, AND CLASS MEDIANS BY SUBJECTS FOR GRADES 3B TO 6B ON STANFORD ACHIEVEMENT TEST, FORM W
October 1930

Grade	Number	Standard	Educational Age	Paragraph Meaning	Word Meaning	Dictation	Language	Literature	History	Geography	Hygiene	Reasoning Arithmetic	Computation Arithmetic
3Bxy	15	3.1	4.0	4.3	4.3	3.7	---	---	---	---	---	4.0	3.5
3Byz	27	3.1	3.1	3.0	3.1	2.8	---	---	---	---	---	3.3	3.3
3A	26	3.6	4.1	4.0	4.1	3.6	---	---	---	---	---	4.3	4.3
4B	25	4.1	4.4	4.7	4.7	4.0	5.1	4.4	3.3	4.4	4.6	4.6	4.6
4A	26	4.6	4.8	5.7	5.7	4.6	5.1	4.6	3.1	4.8	4.7	5.3	4.8
5Bxy	33	5.1	5.5	5.7	5.7	5.6	6.7	4.6	4.8	5.0	5.8	6.1	5.2
5Byz	23	5.1	5.1	5.7	5.5	4.6	6.0	4.4	4.4	4.9	5.1	5.5	4.9
5A	35	5.6	5.7	5.8	5.8	5.1	6.1	5.7	5.1	5.9	5.9	5.7	5.6
6Bxy	22	6.1	6.8	6.8	7.2	6.3	7.5	6.8	5.6	6.3	6.4	7.1	7.6
6Byz	18	6.1	5.8	5.7	5.7	5.0	6.0	5.9	5.0	5.4	5.5	6.1	7.2

TABLE II
STANDARDS, EDUCATIONAL AGES, AND CLASS MEDIANS BY SUBJECTS FOR GRADES 3A TO 6A ON STANFORD ACHIEVEMENT TEST, FORM X
May 1931

Grade	Number	Standard	Educational Age	Paragraph Meaning	Word Meaning	Dictation	Language	Literature	History	Geography	Hygiene	Reasoning Arithmetic	Computation Arithmetic
3Axy	15	3.8	4.7	4.7	4.9	4.4	---	---	---	---	---	5.0	4.6
3Ayz	27	3.8	3.8	3.6	3.9	3.2	---	---	---	---	---	4.0	4.5
4B	26	4.3	4.6	4.9	4.9	4.4	---	---	---	---	---	4.3	4.6
4A	25	4.8	5.3	5.4	5.3	4.6	6.8	5.4	4.6	5.0	4.9	5.8	5.2
5B	26	5.3	5.9	6.4	5.8	5.6	6.8	5.8	4.8	5.9	5.9	5.9	5.7
5Axy	33	5.8	6.6	7.0	6.7	6.2	7.8	5.5	5.2	6.1	6.0	7.0	8.5
5Ayz	23	5.8	5.6	5.7	5.9	5.3	6.6	4.7	4.7	5.3	5.8	5.6	6.7
6B	35	6.3	6.4	7.0	6.2	6.2	7.8	5.7	5.2	6.3	6.1	6.1	7.2
6Axy	22	6.8	7.7	8.2	7.9	7.4	8.4	7.4	7.1	6.8	7.1	7.1	9.8
6Ayz	18	6.8	6.7	6.4	6.2	5.9	7.0	6.6	5.2	6.4	6.6	6.6	9.8

TABLE III
STANDARDS, EDUCATIONAL AGES, AND CLASS MEDIANS BY SUBJECTS
FOR GRADES 3B TO 6B ON STANFORD ACHIEVEMENT TEST, FORM Y
October 1931

Grade	Number	Standard	Educational Age	Paragraph Meaning	Word Meaning	Dictation	Language	Literature	History	Geography	Hygiene	Reasoning Arithmetic	Computation Arithmetic
3Bxy	*	3.1	3.5	3.6	4.1	3.1	---	---	---	---	---	3.3	3.2
3Byz		3.1	2.8	2.5	2.7	2.6	---	---	---	---	---	2.9	3.1
3A		3.6	3.4	3.5	3.3	3.1	---	---	---	---	---	3.3	4.0
4Bxy		4.1	5.4	5.0	5.3	5.2	6.5	5.9	5.2	5.1	6.1	5.1	4.8
4Byz		4.1	4.2	4.1	3.5	3.4	5.3	4.2	3.5	4.3	4.9	4.4	4.5
4A		4.6	5.0	4.9	5.4	4.6	5.9	4.7	4.5	4.7	5.4	4.7	4.7
5Bxy		5.1	5.7	6.3	6.2	4.7	6.2	5.7	5.5	5.1	6.1	6.1	5.0
5Byz		5.1	5.2	5.3	5.2	4.1	6.2	5.6	5.1	4.9	5.7	5.5	4.9
5A		5.6	6.0	6.8	6.1	5.6	7.1	5.8	5.2	5.5	6.2	5.8	6.0
6Bxy		6.1	7.0	7.2	6.8	6.5	8.2	6.7	5.6	6.2	6.7	7.4	8.6
6Byz		6.1	6.1	6.2	5.7	4.9	6.8	5.9	5.7	5.7	6.3	6.1	7.5

* Numbers approximately the same as in Tables I and II, but records not available due to earthquake.

TABLE IV
STANDARDS, EDUCATIONAL AGES, AND CLASS MEDIANS BY SUBJECTS
FOR GRADES 3A TO 6A ON STANFORD ACHIEVEMENT TEST, FORM Z
May 1932

Grade	Number	Standard	Educational Age	Paragraph Meaning	Word Meaning	Dictation	Language	Literature	History	Geography	Hygiene	Reasoning Arithmetic	Computation Arithmetic
3Axy	*	3.8	4.2	4.1	4.4	3.9	---	---	---	---	---	4.0	4.7
3Ayz		3.8	3.2	2.9	3.3	2.8	---	---	---	---	---	3.2	3.7
4B		4.3	4.7	4.1	4.8	4.4	---	---	---	---	---	5.0	5.0
4Axy		4.8	6.2	5.9	5.8	5.7	8.0	7.5	5.8	5.9	6.3	5.7	5.1
4Ayz		4.8	4.9	4.5	4.6	4.5	5.6	4.8	4.2	4.9	5.6	4.9	5.1
5B		5.3	5.5	5.6	5.9	5.4	5.8	5.3	5.6	5.4	5.6	5.4	5.1
5Axy		5.8	6.8	6.8	7.3	5.7	7.3	6.6	6.4	5.8	6.5	6.7	8.5
5Ayz		5.8	5.8	5.8	6.0	4.9	6.2	5.5	5.5	5.4	5.8	5.7	7.1
6B		6.3	6.8	6.5	7.3	6.7	7.3	7.0	5.7	6.1	6.3	6.6	8.2
6Axy		6.8	7.8	7.3	8.3	7.1	8.9	8.0	5.7	7.5	7.1	8.2	9.8
6Ayz		6.8	6.8	6.3	7.1	5.4	7.5	6.4	5.5	6.6	6.3	7.6	9.7

* Numbers approximately the same as in Tables I and II, but records not available due to earthquake.

SOCIAL PROBLEMS AS A BASIS FOR A VITALIZED ARITHMETIC CURRICULUM

by
Leo J. Brueckner
University of Minnesota

It would not be difficult to defend the general thesis that one of the major functions of the school is to give the child a clear understanding of the present social order and the direction in which it is progressing so that he may live more richly and effectively in it. One of the most direct ways of achieving this end is for the child, under the guidance of the teacher, to make a systematic study of current social problems that arise in life about him. It is obviously essential that these problems should be carefully selected so that the work on them may be of real significance and importance.

One very fruitful source of current social problems of recognized cruciality is Hockett's book, The Determination of Major Social Problems of American Life, in which he presents an analysis of the social problems and issues found in the writings of frontier thinkers. This book has been used as the source of problems that have been made the basis of some of the new textbooks on the social studies, for example, the Rugg Social Science Course. An examination of the content of these textbooks shows that problems dealing with economic matters, such as business, taxation, tariff, banking, and the like have not been included in them. It, therefore, appears that these writers feel that the place for their consideration is in some subject other than social science.

When one realizes that much of the content of arithmetic as now taught deals with the quantitative aspects of social institutions the question arises as to why more consideration has not been given to the social problems that are pressing for a solution in the institutions which are the backbone of the arithmetic course. To determine what these problems are the writer made an analysis of the problems listed by Hockett that might well be introduced into the work in arithmetic. If a systematic discussion of their implications and possible solutions were to be made the basis of the work in the phases of arithmetic to which they are related such as banking, buying, selling, taxation, and the like it is obvious that that subject would in a short time be raised from the level of routine drill and practice in solving so-called "problems" and would become a social study of the first order.

Below is presented a topical analysis of problems as listed by Hockett that might be considered in the courses in arithmetic. Illustrative problems are given under each heading. The numbers of other typical problems of a similar type found in Hockett's book are included. The reader can refer to the original to get the problems.

I. Problems and issues of government
  a. Social Legislation
    Type problem (69): Should the state establish minimum wages in some or all industries? For all workers? For women workers?
    Others: 68, 70, 72
  b. The Tariff
    Type problem (75): Should we maintain a protective tariff or free trade?
    Others: 76, 119, 121
  c. Finance and Taxation
    Type problem (79): The problem of securing wise expenditure of public money without extravagance or unwarranted economy.
    Others: 77, 81, 82, 84, 85, 109, 119, 121
  d. National Defenses
    Type problem (90): Should World War veterans be granted a

bonus by the federal government? If so, of what amount and type?
Others: 87, 89

e. City Government
Type problem (109): The problem of insuring sound financing of cities, to prevent their living beyond their means. Should the borrowing capacity of cities be arbitrarily restricted?
Others: 106

II. Problems and issues of business and industry

a. Economic motives, aims, and attitudes
Type problem (147): The problem of abolishing special economic privileges which enable individuals to receive profits and rewards disproportionate to their economic services. Organizing industry and business so that profit will be commensurate with excellence of product.
Others: 145, 146, 148, 149, 150

b. Form of economic organization and industrial control
Type problem (157): Should all electrical power be publicly owned and distributed?
Others: 151, 155, 158

c. Distribution of wealth
Type problem (160): The problem of securing a more equal, a morally and socially desirable, distribution of wealth and social income.
Others: 161, 162, 163

d. Business methods
Type problem (167): The problem of regulating the investment of capital between industries to prevent both underproduction and overproduction.
Others: 164, 165, 166, 168

e. Banking and finance
Type problem (172): The problem of stabilizing exchange.
Others: 169, 170, 171

f. Economic wastes and abuses
Type problem (175): The problem of stabilizing the industrial cycle, preventing fluctuations in industrial activity with consequent depression, unemployment, poverty, and waste.
Others: 173, 174, 176

g. Relations of capital and labor
Type problem (182): Should profit sharing be widely adopted? Will it solve the difficulties of capital and labor?
Others: 177, 178, 179, 180, 181, 183, 184

h. Protection and improvement of the condition of labor
Type problem (185): The problem of so organizing industry that workers will have incentives to devote their full productive energy, intelligence, and initiative to their work.
Others: 187, 188, 189, 190, 192, 193

i. Production of goods and development of resources
Type problem (208): The problem of providing research and inquiry for the improvement of the standards of service in the various trades and industries.
Others: 206, 207, 209, 211, 212, 213, 214, 215

j. Buying and selling
Type problem (219): The problem of reducing advertising to the minimum required by social welfare. Preventing falsehood and deception in advertising.
Others: 220, 221, 222

k. Economic consumption
Type problem (226): The problem of reducing the waste in consumption caused by extreme dictates in fashion in clothing and by yearly models of automobiles, typewriters, etc.
Others: 223, 224, 225, 227

l. Corporations and monopolies
Type problem (229): The problem of regulating or controlling municipal monopolies so that they serve the best interests of the whole community. Should they be privately owned and

operated, publicly owned and operated, or publicly owned and leased for private operation?

Others: 228, 230, 233, 235

m. The railroads

Type problem (240): The problem of determining and regulating railroad rates, freight, and passenger, and developing a suitable technique for the purpose.

Others: 237, 238, 241

n. Coal

Type problem (246): The problem of securing the facts and publicity for the facts regarding the coal industry: ownership, production, distribution, costs, sales, profits, monopoly.

Others: 243, 245

o. The farmer

Type problem (248): The problem of improving the condition of the farmer. Freeing him from exploitation, securing lower taxes and transportation rates and better roads for him. Through what means, if any, should the government extend aid to farmers? Federal farm loans, price fixing, grain control, tariff on farm products?

Others: 249, 251, 252

III. Social problems

a. Immigration

Type problem (280): The problem of restricting and regulating immigration in the interest of the welfare of the whole country. Determining the numbers to be admitted and bases of selection of immigrants.

Others: 283

b. Problems of education

Type problem (306): Should the federal government give greater financial aid to education?

Others: 294, 308, 310

c. The press

Type problem (314): The problem of freeing the press from the domination of advertisers and special interests, and preventing suppression, misrepresentation, and falsification of news and the use of the editorial and news columns for propaganda.

Others:

d. Miscellaneous social problems

Type problem (332): The problem of securing wise, far-seeing city and regional planning. Regional zoning and planning of industries, residences, transit facilities, recreational facilities, size of buildings, width and direction of streets, etc.

Others: 333, 334, 339, 341

IV. Problems and issues of international affairs

a. War and armaments

Type problem (344): The problem of eliminating the war danger due to private gain from munitions.

Others: 348

b. International cooperation

Type problem (356): Should tariff barriers be settled internationally?

Others: 359

c. International economic problems

Type problem (364): The problem of eliminating periodic depressions in world trade.

Others: 361, 362

AN ACTIVITY ANALYSIS OF SECRETARIAL DUTIES AS A BASIS FOR AN OFFICE PRACTICE COURSE

by
Doris Tyrrell
College of Education
University of Minnesota

In institutions where business training is given, the content of the curriculum designed to train secretaries, to mention only one field of specialization, has been determined largely by individual opinion. The individual responsible for selecting content material may have based his decision upon a more or less limited personal experience, or lacking confidence in himself, he may have resorted to the adoption of the courses offered by some other school. In either case, he has seldom had the definite information necessary to guide him in constructing the curriculum most helpful to the future secretary. As a preliminary step in the preparing of training courses for a profession or semi-profession an analysis of the activities of the particular job seems especially appropriate. When the activities have been listed and evaluated in the light of certain criteria, such as frequency of performance, importance, difficulty of learning to perform, and desirability of pre-service training, they ought to furnish valuable basic material upon which the training courses can be built.

Without a doubt, the most important contribution to curriculum construction in secretarial training was made in 1924 by Charters and Whitley in their study, Analysis of Secretarial Duties and Traits.[1] Among the suggestions for making use of this study, the investigators propose that teachers check the content of commercial courses against the duty list. Careful inspection of the list, however, indicates the inadvisability of depending upon frequency with which an activity occurs in a certain group as an index for inclusion in a training course. Duties such as dusting, sharpening pencils, and sealing mail would scarcely occupy in a secretarial training curriculum the important position suggested by their high rank with respect to frequency of performance. On the other hand, it may well be that duties ranking fairly low in the number of times performed, when evaluated on the basis of their importance in the efficient conduct of an office and on other criteria, would call for considerable emphasis in any training program.

PURPOSE OF THIS STUDY

This study was undertaken to attempt to determine the content of an office practice course in a junior college secretarial curriculum by evaluating secretarial duties found in the list compiled by Charters and Whitley. In addition to frequency rating, already available in the study mentioned, the three additional criteria used in The Commonwealth Teacher-Training Study by Charters and Waples[2] were applied. These criteria are I (importance), D (difficulty), and S (desirability of pre-service training). Scores were then obtained for I, D, S, and F (frequency) and combined to give a composite score (C) for each duty. Lastly, the duties were ranked on the basis of the C-scores.

THE CHECK-LIST

Since it was soon evident, when the check-list was sent out to college teachers in mimeographed form, that the entire list of 871 duties found in the Charters and Whitley study was too formidable to secure enough replies for a reliable study, it was decided to limit the list to those classes of duties which might be expected to receive consideration in an office practice

1. W. W. Charters and Isadore B. Whitley, Analysis of Secretarial Duties and Traits. Baltimore, Maryland: Williams and Wilkins Company, 1924.
2. W. W. Charters and Douglas Waples, The Commonwealth Teacher-Training Study. Chicago, Illinois: The University of Chicago Press, 1929.

course. An assumption was made that aside from an office practice course, a secretarial curriculum will include courses in at least four technical branches -- shorthand, typewriting, bookkeeping, and secretarial English. The courses in shorthand may be expected to take care of duties classified under dictation and transcription; the courses in typewriting, the typewriting duties; the courses in bookkeeping and accounting, the bookkeeping and financial duties; and the course in secretarial English, the editorial duties. In addition, the secretarial English course is probably the appropriate place to teach the letter-writing activities found in the remaining groups of duties. These letter-writing activities, however, were not excluded from the final printed check-list. In this list, then, appeared all mailing duties, filing duties, duties connected with filing and indexing, telephone duties, duties involved in meeting and handling people, clerical duties, personal services for employer, and miscellaneous duties. The exclusion of certain classes of duties from the office practice course does not mean they may not be taken up incidentally. Their performance, however, should have been learned elsewhere.

THE JUDGES

Teachers of secretarial courses and secretaries seemed the two groups best qualified to give judgments expressed in terms of the three criteria. Since the study was to be concerned with junior college courses only college and university instructors were approached. Likewise, only secretaries with college training at least through the junior college level were considered.

The Instructors

Letters requesting catalogs of courses were sent to the 286 junior colleges and the eighty-eight collegiate schools of commerce listed in the Educational Directory for 1931.[1] Two hundred twenty-one junior colleges and eighty-four collegiate schools of commerce responded. When the 305 catalogs were examined, secretarial training was found in 109 junior colleges, while special training in secretarial work was offered in thirty-seven collegiate schools of commerce.

Letters and printed check-lists were sent to 151 instructors in the 109 junior colleges and to ninety-six instructors in the thirty-seven collegiate schools of business. In most instances, each instructor in the department received a check-list, but in a few cases where the department was very large and it was impossible to tell from the catalog which instructors were connected with the secretarial phases of business training, a letter and two blanks were sent to the head of the department.

From junior college instructors came twenty-seven replies that could be used. Added to these replies were five check-lists received from instructors in four-year colleges having secretarial departments but not having separate schools of business. These replies had come in when the unabridged, mimeographed check-list was sent out and before a systematic attempt to obtain judges had been made. They were included in the junior college group because the organization of their training departments seemed more nearly to approximate that of the junior colleges than the organization found in the collegiate schools of business. Thirty complete and usable replies came from the instructors in collegiate schools of business.

The Secretaries

As previously mentioned, only secretaries with at least two years of college training were asked to give their judgments. They were not, however, confined to those who had received their business training in a junior college or four-year institution. Secretaries for judging the duties were obtained through the assistance of the following organizations:

Collegiate Bureau of Occupations, Chicago	10	secretaries
Woman's Occupational Bureau, Minneapolis	15	"
Zonta Club, Minneapolis	1	"

1. Educational Directory. United States Department of the Interior Bulletin, No. 1. (Washington D. C.: United States Government Printing Office, 1931.)

Altrusa Club, Minneapolis... 4 secretaries
Colleges and Universities
(unexpected returns because blanks intended for instructors were filled out by secretaries)..... 4 "
Total..... 34 "

At first, an effort was made to find secretaries distributed among various offices in proportions equal to those of the original study by Charters and Whitley.[1] As it became increasingly difficult to get judges, however, this aim received secondary consideration. There is a fairly close approximation in the two studies in percentages in the classifications of general business, editors, social service, educators, lawyers, and doctors. Statisticians and engineers are not represented in this study, while bankers' secretaries have contributed somewhat more than their share of judgments. This will probably mean that the frequency rankings taken from the Charters and Whitley study will not be entirely representative of the situation in this investigation.

STATISTICAL TREATMENT OF THE DATA

For each duty in the check-list, the judges were asked to record their opinions on the basis of the three criteria, I (importance of the duty for the efficient conduct of an office), D (difficulty of learning to perform the duty), and S (desirability of pre-service training in the duty). If the one doing the judging was so unfamiliar with a duty that he did not feel qualified to express an opinion, he placed a dash in the three columns for I, D, and S. If he considered the duty very important, very difficult to learn, or if he thought that it should be learned in school, he placed an x in the proper column. With an o in the appropriate column, he indicated that, in his opinion, the duty was of little importance, or of little difficulty, or should not be learned in school. By leaving a column blank opposite any duty, he indicated that the duty was average when judged by that particular criterion.

The returns of the junior college instructors and university instructors in collegiate schools of business were at first kept in separate groups. Thus, there were three groups of judges: the secretaries and the two groups of instructors. In order to facilitate later computation of reliability coefficients, the three groups were each divided into two sub-groups by distributing the replies alternately to two piles. Then tally sheets with columns headed x, o, b were prepared for each of the criteria, I, D, and S.

Method of Correcting Columns x, o, and b Checked by Two Groups of Instructors. A duty checked by a dash, it will be remembered, indicated that the judge was not sufficiently familiar with the activity to rate it. In order to make the sums of the x, o, and b columns comparable, it was necessary to estimate the score that would have resulted had all the judges in a group rated the duty. The technique for distributing the dashes used by Charters and Waples[2] was first tried. The formula is

$$\frac{\text{number of returns}}{\text{number of returns - number of dashes}} \times \text{the number of x's, o's, or b's recorded for the duty.}$$

This assumes, of course, that the ratings already given the duty were representative of the ratings which the entire group would have given.

Method of Obtaining from Checks of Instructors a Score for Each Duty. To obtain an I, D, and S score for each duty the method used in The Commonwealth Teacher-Training Study[3] was employed; i.e., the number of x's (as corrected) was multiplied by 3, the number of b's by 2, and the number of o's by 1, the three values then being added. This method arbitrarily assumes that an x rating for any duty has three times the weight of an o rating, and that a b rating has twice the weight of an o rating. This assumption and these weights were also employed by Charters and Waples.

When the method of correction explained above was put into practice, it was found that in many instances the dashes were so distributed that the cases added up either to one more or to one less than the actual

1. W. W. Charters and Isadore B. Whitley, Analysis of Secretarial Duties and Traits (Baltimore, Maryland: Williams and Wilkins Company, 1924), p. 69
2. W. W. Charters and Douglas Waples, The Commonwealth Teacher-Training Study (Chicago, Illinois: The University of Chicago Press, 1929), pp. 251-52
3. Ibid. p. 252

TABLE I

RELIABILITY COEFFICIENTS OBTAINED FOR THREE GROUPS OF JUDGES RATING SECRETARIAL DUTIES

Classes of Duties	No. of duties	Importance						Difficulty						School					
		Junior College Instructors		University Instructors		Secretaries		Junior College Instructors		University Instructors		Secretaries		Junior College Instructors		University Instructors		Secretaries	
		r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$
I. Mailing Duties	32	.75	±.21	.90	±.09	.92	±.07	.91	±.06	.91	±.08	.85	±.13	.90	±.09	.86	±.13	.90	±.09
II. Filing Duties	97	.84	±.08	.79	±.11	.86	±.07	.45	±.18	.29	±.20	.42	±.19	.70	±.14	.60	±.16	.56	±.17
III. Duties Connected with Filing, Indexing, etc.	36	.94	±.05	.83	±.14	.87	±.12	.86	±.13	.83	±.14	.95	±.04	.94	±.05	.86	±.13	.85	±.13
IV. Telephones, etc.	20	.77	±.25	.79	±.23	.85	±.18	.87	±.16	.37	±.42	.55	±.37	.54	±.38	.81	±.22	.33	±.43
V. Duties Involved in Meeting and Handling People	79	.87	±.08	.81	±.11	.88	±.07	.90	±.08	.84	±.10	.78	±.12	.67	±.16	.83	±.10	.63	±.17
VI. Clerical Duties	77	.87	±.08	.86	±.08	.84	±.10	.76	±.13	.73	±.15	.80	±.12	.92	±.05	.87	±.08	.77	±.13
VII. Miscellaneous Duties and Personal Services for Employer	65	.90	±.07	.70	±.17	.77	±.14	.82	±.11	.74	±.15	.88	±.08	.90	±.07	.80	±.12	.84	±.10
All Duties	406					.83	±.04					.85	.04					.75	±.06

number found in each of the various sub-groups. Therefore, a further correction was made. This formula was used:

$$\frac{\text{no. of cases in group}}{\text{no. of cases resulting after distributing dashes}} \times \text{the score obtained.}$$

Method of Obtaining from Checks of Secretaries a Score for Each Duty. A formula similar to the preceding one was used to distribute the dashes and compute the scores for the two sub-groups of secretaries. This was substituted for the correction formulas used for the instructors. The formula is $\frac{17 \text{ (number of cases)}}{17 - \text{number of dashes}}$ x score obtained by adding values of columns x, o, and b. As before, the values of the x, o, and b columns were found by multiplying the number of x's tabulated for a duty by 3, the number of b's by 2, and the number of o's by 1.

Reliability of the Sample. As already explained, the replies from each of the three groups of judges were divided into two sub-groups by distributing the replies alternately to two piles. One of the sub-groups of each larger group is referred to as the "A" group and the other as the "B" group.

Reliability coefficients were obtained for the three groups of judges in the three categories, I, D, and S. Taking the seven classifications of duties separately, coefficients of correlation were calculated between weighted scores of the sub-groups: junior college instructors A and B, university instructors A and B, and secretaries A and B. Since these coefficients were representative of the reliability of the composite judgment of the halves of the groups, the Spearman-Brown prophecy formula, $r_{nn} = \frac{n r_{II}}{1 + (n-1) r_{II}}$ was then applied in order to obtain an estimate of the reliability of the complete groups. The standard error of r_{nn} was found by using Shen's[1] formula. The coefficients of reliability and standard errors found are given in Table I.

Under D, low reliability coefficients resulted for filing duties in all groups; for telephone duties in the groups of university instructors and secretaries. Under S, the low reliability coefficients were found for filing duties in the groups of university instructors and secretaries; for telephone duties in the groups of junior college instructors and secretaries; and for duties under meeting and handling people in the groups of junior college instructors and secretaries. Somewhat higher reliability coefficients for these duties were obtained by correlating the weighted scores secured from the university and junior college instructors combined and by applying the Spearman-Brown prophecy formula. The results are shown in Table II.

Decile Ranks in I, D, and S. In accordance with the technique employed by Charters and Waples, the activities or duties in the check-list were next given decile ranks on the basis of the weighted scores. In each of the three categories, I, D, and S, the duties were arranged in order from highest to lowest according to the scores obtained from each of the three groups of judges, the two groups of instructors combined, and all three groups combined. Duties falling in the first decile, or approximately

TABLE II
RELIABILITY COEFFICIENTS FOR ALL INSTRUCTORS COMPARED WITH RELIABILITY COEFFICIENTS FOR JUNIOR COLLEGE INSTRUCTORS AND FOR UNIVERSITY INSTRUCTORS

Classes of Duties	Criterion	All Instructors		Junior College Instructors		University Instructors	
		r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$	r_{nn}	$\sigma_{r_{nn}}$
Filing Duties	Difficulty	.53	±.17	.45	±.18	.29	±.20
Telephone Duties, etc.	Difficulty	.92	±.10	.87	±.16	.37	±.42
Filing Duties	School	.84	±.08	.70	±.14	.60	±.16
Telephone Duties, etc.	School	.84	±.18	.54	±.38	.81	±.22
Duties Involved in Meeting and Handling People	School	.85	±.09	.67	±.16	.83	±.10

1. Eugene Shen, "The Standard Error of Certain Estimated Coefficients of Correlation." Journal of Educational Psychology, Vol. XV (October, 1924), pp. 462-64.

forty duties with the highest scores, were designated by the number 1; duties falling in the second decile were designated by the number 2, and so on through the tenth decile.

Decile Ranks in F. The frequency with which each duty was performed is not indicated by a score, but by actual count. The frequencies are found in the original list of secretarial duties. The decile rank for the frequency of each duty was obtained by ranking the duties according to the number of secretaries who reported that they performed them. Again, duties falling in the first decile for F were designated by the number 1, and so on through the tenth decile.

Decile Ranks in C. Since the scores for F and those for I, D, and S were obtained in entirely different ways and are not comparable, the raw F scores could not be added to the I, D, and S scores to get the composite score (C). To overcome this difficulty, all were converted to standard scores. The percentile rank of each duty in F, I, D, and S for junior college instructors, university instructors, junior college and university instructors, secretaries, and all instructors and secretaries was computed. By these percentile ranks, the standard scores were read from the Kelley-Wood Table.[1]

The standard scores for F, I, D, and S under each of the five groups were then added and the composite scores ranked to obtain decile ranks. As before, duties falling in the first decile were designated by the number 1, and so on through the tenth decile.

To gain some idea of the degree of agreement between the two groups of instructors and between the instructors and secretaries on the entire list of activities, coefficients of correlation were calculated between the deciles in which the various activities were placed by the two groups of instructors and the secretaries. These are given in Table III. Since the secretaries agree with the instructors to about the same extent as the junior college group agrees with the university group on the C-score rankings, it is impossible to say which ranking should be used in constructing a course. For the purpose of this study the C-score ranks obtained from the combined scores of the three groups would seem to be the best guide for course construction. The fact that that there are nearly twice as many teachers as secretaries is offset, the writer believes, by the fact that sixty-one per cent of the instructors have had business experience, a circumstance which must necessarily have affected their judgments.

It was suggested in stating the problem that some duties ranking high in frequency would receive less emphasis if judged by additional criteria, and vice versa. A few of the duties occurring very frequently but judged so low in I, D, and S as to place C (composite score) in the lower deciles are: (2) open mail (ninth decile), (4) forward mail (ninth decile), (13) take mail to post office (tenth decile), (280) place articles on desk in order (seventh decile), (298) look up names and addresses (sixth decile), and

TABLE III
CORRELATIONS BETWEEN DECILE RANKS OBTAINED FROM RATINGS GIVEN BY UNIVERSITY INSTRUCTORS AND JUNIOR COLLEGE INSTRUCTORS, AND BY ALL INSTRUCTORS AND SECRETARIES TO 406 SECRETARIAL DUTIES

	Junior College Instructors and University Instructors		All Instructors and Secretaries	
Criteria	r	P.E.$_r$	r	P.E.$_r$
I	.76	±.014	.73	±.015
D	.82	±.011	.83	±.010
S	.85	±.009	.76	±.014
C	.87	±.008	.85	±.009

TABLE IV
CORRELATIONS BETWEEN DECILE RANKS OBTAINED FOR THE FOUR CRITERIA USED BY THE COMBINED GROUPS OF JUDGES IN RATING 406 SECRETARIAL DUTIES

Criteria	I		D		S	
	r	P.E.$_r$	r	P.E.$_r$	r	P.E.$_r$
F	.43	±.026	-.41	±.027	.21	±.032
I			.24	±.030	.67	±.018
D					.34	±.028

[1] Truman L. Kelley, Statistical Method, Appendix C (New York: The Macmillan Company, 1923), pp. 373-385

(346) dust (tenth decile). Of the duties occurring rather infrequently but judged so high in I, D, and S as to place the C-scores in the higher deciles are the following: (201) arrange itineraries for speakers, salesmen, etc. (third decile), (243) organize office (first decile), and (261) handle compensation insurance (third decile).

Taking the C-score rankings of the combined groups of judges, intercorrelations of F, I, D, and S decile ranks were made. These are shown in Table IV. The highest correlation, .67 ±.018, occurs between I and S, and indicates a tendency for those duties considered important to be ranked high in desirability of training in school. The one negative correlation between F and D shows the tendency to judge a duty frequently performed as less difficult to learn to perform. All the other correlations are positive but too low for predictive purposes.

EVALUATION OF THE DATA

In Table V[1] are given the decile ranks of the 406 secretarial duties for F, and for I, D, and S as judged by all the instructors and the secretaries, and the C-score ranks resulting from the combined judgments of all groups of judges.

These C-score ranks are, at best, approximations. They have been affected by the imperfect reliabilities of the groups judging the activities and by the possible errors in weighting scores both for individual criteria and for the final C-scores. They have also been affected by the fact that some of the duties were too little known to be ranked by a large number of the judges. In distributing proportionately the dashes tabulated for such duties, the number assigned to x's, o's, and b's has been determined by the few who felt capable of judging the duties. For example, for duty 199, give talks and lectures of various kinds, twenty-one secretaries said they knew nothing about this duty, six marked it x for S, three marked it o, and four left the space opposite the item blank; eight placed an x opposite this duty for D, and five left the space blank; seven marked it x for I, one marked it o and five left the space blank. Since most of the few secretaries who judged this duty gave it an x or b rating for I, D, and S, these ratings were further increased by the distributed dashes representing those who were unfamiliar with the duty. As a result, this duty received from the secretaries a decile rank of 3 for I, 1 for D, and 2 for S, and 2 for C. The instructors, more of whom seemed to feel qualified to judge this duty, gave it a much lower decile rating except for the criterion D. In this case and a few other similar ones, in which a large number of any one group of judges is unfamiliar with the duty, it seems doubtful that the rating based upon judgments of that group, or the combined ratings of all the judges, is truly accurate. Further imperfections may be due to the possibility that duties which a secretary ought to perform are omitted from the list and that other duties which a secretary ought not to perform are included.

The writer feels that the two sections on filing duties, and duties connected with filing and indexing are the least satisfactory as guides in curriculum construction. Items which seem enough alike to be combined have been listed separately. It is true that these duties are scattered in the lists of C-score ranks, and it is also true that some very low reliability coefficients were obtained on these sections. Just why file bills (No. 100) with a rank of 32 should be placed ahead of file receipts (No. 101) with a rank of 40 is hard to explain, as are almost any of the ranks for filing duties. Furthermore, saying that there are differences between keeping card indexes of correspondents, of prospects, of customers, and of clients (Nos. 138, 139, 140, and 141) with ranks of 107, 55.5, 81, and 157 respectively, seems like splitting the proverbial hair. True, there may be differences in the types of record cards, but that has been left to the interpretation of the reader. Possibly an average of the ranks of duties which appear to be so similar would be more valuable than individual ranks. In the above instance, that average rank would be approximately 100 and the decile rank 3.

In this connection, attention should be called to the fact that, to teach filing, one needs to know not only what is filed but how it is filed. After all, a letter can be filed in one of many ways depending upon

[1] Table V, pp. 332-340

the system in use. It may be filed alphabetically by name of correspondent, by subject, by geographic location of correspondent, by number, etc. Such a study as this gives no indication of the popularity of any of these systems or the difficulty of using them.

An additional limitation of the list lies in the fact that some of the duties might have been consolidated to advantage and others expanded or explained. For example, it seems to the writer that the first three items under telephone duties, use of telephone (local), use of telephone (long distance), and answer telephone could have been combined without detriment, as could the four items pertaining to sending and receiving telegrams and cablegrams. Although these items will be found scattered more or less in the table presenting C-score ranks, suggesting that, after all, they are better left separate, it must also be remembered that there were some rather low reliability coefficients obtained on this section. Then, there are duties in the list which are extremely indefinite or very comprehensive, so comprehensive as to be suggestive of material for an entire course. Such a one is the duty, manage office (No. 244). How many of the other activities this duty includes is hard to determine, but it seems reasonable, after reading the list, to suppose there are many. Operate comptometer (No. 318) seems at first to express a single ability, but several kinds of mathematical computations, some of them very complicated, can be performed on the comptometer. Which ones shall be taught secretaries? Likewise, the duty ranking first in all the C-score lists (write letters not dictated) gives no indication of the types of letters a secretary is expected to write without dictation. Ranking somewhat lower are invitations and letters of congratulation and condolence, but there is no definite statement that these duties belong in the write letters not dictated classification.

Certain activities appearing in the check-list seem to belong in some other course than office practice. In the statement telling how items of the abridged check-list were selected, it was mentioned that letter-writing activities occurring in the seven sections chosen would naturally be taught in the secretarial English course. In institutions not offering a special course in English for secretaries, such activities may be taken up in several different courses. The dictated letter, of course, is considered in the dictation course, but as already pointed out, the letter composed by the secretary herself also occurs frequently and is important and difficult to write. It may be that, in the absence of an English course for secretaries, training for this duty should be given in office practice. The activity, cut stencils (No. 382), is primarily a typewriting operation, but whether it is taught in a typewriting course or in office practice is a matter of little significance. The important thing is that it ranks rather high in the C-score list. It may be that there is justification for teaching the operations of stencil cutting in two courses. For example, the typewriting operation might be taught in the typewriting class, while diagram and figure tracing, ruling, and various uses of the different styli might be presented in office practice.

In spite of the limitations of the final C-score list just noted, the list is sufficiently detailed and reliable to furnish valuable clues to those interested in establishing in a junior college an office practice course for secretaries, as well as to serve as a check of the content of office practice courses now being offered. Some ways of using the list will be suggested below.

To discover, if possible, any differences in the types of activities of high and low ranks, the duties falling in the three highest deciles and the three lowest deciles (column C under "instructors and secretaries", Table V) were studied. While filing duties are noticeably scattered throughout the entire list, it is evident that those requiring more than routine skill are very near the top in rank. They are install filing system (No. 151) with a C-score rank of 4 and revise files (No. 152) with a C-score rank of 6. In addition, the ability to write letters not dictated (if included in this course), to meet people under a variety of conditions (including the medium of the telephone), to plan work for one's self and

see that it gets done are found in these highest deciles. Also, the necessity to teach the operation of the more common office appliances is evident. Frequently, specific items illustrate these comprehensive activities and suggest the trends of the activities. For example, under meeting people, it is noticeable that knowing how to meet callers and adjust complaints should, in the opinions of the judges, receive more emphasis than knowing how to handle bundle boys and messengers. Likewise, while the section on filing is inadequately treated by the technique of this study, the ranks of the various materials filed suggest the most appropriate illustrative material in teaching methods of filing.

The duties found in the last three deciles, while they fall under the classifications of those present in the three highest deciles, impress one, in general, as either extremely simple or highly specialized. Some of the very simple ones are stamp letters, straighten up office, rule reports, sign circular letters, trace maps, errands, open mail, call taxis, wind clock, take care of flowers, etc. In the highly specialized group are assist with laboratory work, dress windows, take X-ray pictures, and give gas to dental patients.

In a practical course, it would seem that the highest ranking duties ought to be performed and thoroughly learned during the training period. Those of low rank will probably be ignored or merely mentioned. Between these extremes fall the duties requiring discussion in class but little or no practice. How many items in any office practice course will be handled in these various ways must be determined by the instructors in accordance with local conditions. Time allotted for the course, the scope of the other secretarial courses, and the personnel of the class will have their influence.

Although without accurate information based upon analysis of textbooks or courses of study, the writer suspects that some of the duties ranking rather high in this list have received little attention from a practical standpoint in the ordinary training course. Among such duties are those concerned with the use of the telephone, particularly the activity, take dictation over the telephone. This activity, with a rank of 49 among 406 duties, is doubtless fully discussed in the training period, but probably less frequently practiced. Another group of duties which may be in danger of neglect by secretarial training institutions above the high-school level are those dealing with the operation of office machines, such as the mimeograph, adding machine, and comptometer (Nos. 317, 316, and 318). According to the ranks of these duties (19, 20, and 22 respectively), they merit considerable attention in an office practice course designed to train secretaries. One also suspects that much is said about meeting and handling people, and planning one's work and the work of others, but that little opportunity is given for performing the specific duties.

Several duties receiving quite different ranks from the judgments of the instructors and the judgments of the secretaries seem so interesting as to deserve some comment. The duty, select furnishings for office (No. 369) is given the C-score rank of 22 by the secretaries but a rank of 234 is given by the instructors. (These ranks and the ones following are not shown in Table V.) Similar to this is the duty, arrange physical layout of office pictures, draperies, etc., (No. 364) which is ranked 149 by the secretaries and 289 by the instructors. Also, secretaries would place more emphasis on writing and acknowledging letters of condolence and congratulation and on writing cards to accompany gifts than would the instructors. The former give these activities ranks of 17, 23, and 36 while the latter rank them 64, 90, and 238.5. It may be that the secretaries feel a serious handicap when confronted with these duties and that teachers should consider them more seriously. Among duties which instructors ranked several deciles higher than did the secretaries are sort mail (No. 3), ranked 147 by the instructors and 302 by the secretaries; figure parcel post rate (No. 14), ranked 82 by the instructors and 256 by the secretaries; and insert letters in envelopes (No. 17), ranked 68 by the instructors and 251 by the secretaries. One can only speculate about the reason for these differences. Possibly, through long practice on these activities, secretaries have forgotten their awkwardness as novices.

TABLE V
DECILE RANKS AND C-SCORE RANKS OF 406 SECRETARIAL DUTIES
OBTAINED FROM JUDGMENTS OF INSTRUCTORS AND SECRETARIES

Duties in Check-List	F	All Instructors				Secretaries				Instructors and Secretaries				C-Score Ranks
		I	D	S	C	I	D	S	C	I	D	S	C	
MAILING DUTIES														
1. Get mail	3	10	10	10	10	10	10	10	10	10	10	10	10	405
2. Open mail	1	6	10	9	9	9	10	10	10	7	10	9	9	354
3. Sort mail	1	3	9	5	4	6	10	10	8	4	9	7	5	188.5
4. Forward mail	1	5	10	9	8	10	10	9	9	7	10	9	9	333
5. Stamp mail (as to date, etc.)	3	7	10	9	9	9	10	10	10	8	10	10	10	379
6. Abstract mail	4	8	3	5	5	7	7	6	6	8	4	5	5	184
7. Read incoming mail	1	3	9	8	5	1	9	8	3	2	9	9	4	149
8. Trace mail	3	9	5	5	6	8	8	7	8	9	6	6	6	229
9. Make notes on mail which superior should see	2	1	3	4	1	1	5	7	2	1	4	5	1	31
10. Weigh mail	2	8	10	6	7	10	10	4	8	9	10	5	8	285.5
11. Sign for registered mail	1	5	10	9	8	10	10	10	10	8	10	9	9	340
12. Have mail registered	1	4	10	6	6	7	10	9	8	5	10	7	7	262
13. Take mail to post office	2	10	10	10	10	10	10	10	10	10	10	10	10	402
14. Figure parcel post rate	3	5	6	2	3	9	10	2	7	7	8	2	4	158
15. Have mail insured	2	4	10	7	6	9	10	8	8	6	10	8	7	257
16. Fold letters	1	4	10	1	2	10	10	1	4	7	10	1	2	79
17. Insert letters in envelopes	1	4	10	1	2	10	10	2	7	8	10	1	4	127
18. Stamp letters, etc.	1	7	10	5	6	10	10	8	10	9	10	6	8	291
19. Address letters, packages, etc.	1	2	10	1	2	6	10	1	3	3	10	1	2	55.5
20. Sign dictator's mail	1	4	10	3	4	6	10	9	7	5	10	5	5	175.5
21. Sign circular letters	2	8	10	5	7	10	10	10	10	9	10	7	8	313.5
22. Mark, attach, or get inclosures	1	1	9	2	2	1	9	3	2	1	9	2	2	42
23. Seal mail	1	5	10	4	5	10	10	10	9	8	10	7	7	264.5
24. Tie up packages	1	8	10	7	7	10	10	10	10	10	10	9	9	340
25. Roll up plans, blue prints, etc.	3	8	10	9	9	10	9	10	10	9	10	9	9	353
26. Read outgoing mail to check up on information, etc.	2	1	4	2	1	1	7	7	2	1	5	3	1	27
27. Read outgoing mail for mistakes	1	1	3	1	1	1	8	2	1	1	5	1	1	10
28. Get franking permit from post office	10	9	9	8	10	9	9	6	10	9	9	8	10	382
29. Make up mailing list	2	2	4	1	1	3	5	3	2	2	4	2	1	33
30. Check mailing list	2	3	8	3	3	6	8	7	6	4	8	4	4	147
31. Revise mailing list	2	2	5	2	2	5	5	6	4	3	5	3	2	75
32. Purchase postage (requisition stamps)	2	9	10	10	10	9	10	10	9	9	10	10	10	369
FILING DUTIES														
File:														
33. Letters	1	1	3	1	1	1	8	1	1	1	5	1	1	3
34. Articles	3	1	3	2	1	3	7	2	3	2	4	2	1	34
35. Case histories	6	3	2	2	2	2	4	1	2	2	3	2	2	57
36. Reports	2	2	5	2	2	2	7	2	2	2	6	2	2	47
37. Minutes	3	3	7	3	3	2	7	2	2	3	7	2	3	85
38. Speeches	4	5	6	3	4	4	6	5	4	5	6	3	4	152
39. Briefs	7	4	3	4	4	4	5	3	4	4	3	3	4	128.5
40. Lectures	5	7	5	5	6	7	4	4	5	7	5	5	5	199.5
41. Memoranda	3	2	5	3	2	2	5	3	2	2	5	3	2	70.5
42. Programs	4	8	7	6	6	7	5	7	6	8	6	6	7	247

Table V (continued)

Duties in Check-List	F	All Instructors				Secretaries				Instructors and Secretaries				C-Score Ranks
		I	D	S	C	I	D	S	C	I	D	S	C	
FILING DUTIES (continued)														
File:														
43. Outlines	4	7	6	5	5	6	4	6	5	6	5	5	5	183
44. Books	7	7	5	5	6	8	7	4	7	8	6	5	7	254
45. Notices	4	6	6	4	5	3	3	4	2	5	5	4	4	136.5
46. Estimates	4	2	3	4	3	2	4	2	2	2	3	3	2	61
47. Specifications	5	2	5	2	2	2	4	2	2	2	4	2	2	63
48. Telegrams	2	1	7	1	1	1	6	3	1	1	7	2	1	24
49. Testimony	8	4	3	3	4	3	4	3	4	4	3	2	4	122.5
50. Copy for newspapers	4	7	4	3	4	5	6	5	5	6	5	3	4	138
51. Requisitions	5	1	5	2	2	4	5	3	4	2	5	2	2	88
52. Sermons	10	8	6	5	9	8	2	6	8	8	5	5	8	307
53. Applications	4	2	6	1	2	2	8	2	3	2	7	2	2	77
54. Recommendations	3	2	5	2	2	4	8	3	4	3	6	2	2	72
55. Advertisements	3	5	6	4	4	5	5	4	4	5	6	4	4	145
56. Cables	5	4	6	2	3	3	7	5	5	4	6	2	4	131
57. Wills	7	4	3	3	4	2	3	3	3	3	3	3	3	111
58. Deeds	8	3	3	2	3	2	4	2	3	3	3	2	3	95
59. Mortgages	8	3	3	2	3	2	3	2	2	2	3	2	3	86
60. Bonds	7	3	2	2	3	2	5	4	3	2	3	3	3	92
61. Contracts	4	1	3	2	1	1	3	2	1	1	3	2	1	21
62. Policies	7	3	3	2	3	2	5	3	3	2	3	2	3	93.5
63. Diaries	9	9	5	6	8	9	3	6	8	9	4	6	8	311
64. Bulletins	5	6	6	3	5	8	7	5	7	7	6	3	5	194
65. Leases	6	3	3	3	3	2	4	3	3	3	3	3	3	98
66. Articles of agreement	5	3	3	3	2	3	4	5	3	3	3	3	2	80
67. Libels in divorce	10	8	4	5	7	6	5	6	8	7	4	5	7	274.5
68. Masters' reports	10	5	3	4	6	7	4	5	7	6	3	4	6	224
69. Petitions	8	6	5	3	5	4	4	5	5	5	4	4	5	190
70. Bills of sale	7	3	4	2	3	3	4	4	4	3	4	2	3	113
71. Releases	7	4	4	3	4	5	4	5	6	5	3	4	5	167
72. Affidavits	6	4	5	2	4	4	5	3	4	4	5	2	4	122.5
73. Claims	6	3	4	3	3	3	4	5	4	3	3	4	3	119
74. Satisfaction of mortgage	8	5	2	3	4	5	4	6	6	5	3	4	5	175.5
75. Increase of capital stock	8	5	2	3	4	5	3	4	5	5	2	3	4	146
76. Return of capital stock	9	5	2	3	5	5	3	4	5	5	2	3	5	169
77. Return of personal property	8	6	4	5	6	5	3	5	5	6	3	5	5	203
78. Liens	9	4	3	4	5	5	3	5	6	4	3	4	5	192
79. Resolutions	7	5	4	4	5	8	5	7	7	6	4	5	5	197
80. Praecipe	10	7	5	4	8	8	5	7	9	8	5	5	8	320
81. Exceptions	10	7	5	3	7	7	5	7	9	7	5	5	7	283
82. Assignments	8	5	4	5	6	4	3	5	5	5	4	5	5	199.5
83. Orders of court	9	5	3	5	6	4	4	8	7	5	3	6	6	225
84. Right of way	10	5	5	4	7	8	6	8	9	6	6	5	8	301
85. Menus	9	10	6	7	10	9	7	8	9	10	7	7	10	366
86. Permits	8	7	5	3	6	6	5	4	6	7	5	4	6	222
87. Quit claims	9	7	5	4	7	7	5	6	7	7	5	4	7	269
88. Laboratory tests	8	6	2	2	4	5	7	7	7	6	3	3	5	174
89. Ordinances	10	7	2	4	6	7	4	6	8	7	3	4	7	246
90. Options	8	6	2	3	4	5	4	7	6	5	2	3	5	171
91. Descriptions of property	6	4	2	3	3	6	3	4	4	5	2	3	3	108
92. Surveys	9	5	3	3	5	7	4	7	7	6	3	5	6	206
93. Settlement sheets	10	6	2	3	7	7	4	8	9	6	3	5	8	288
94. Decrees	10	7	4	4	7	7	5	7	8	7	4	5	7	270
95. Plays	10	10	6	6	10	10	5	8	10	10	6	7	10	376.5
96. Agenda for meetings	8	7	5	5	7	5	5	4	5	6	5	5	6	242
97. Manuscripts	6	4	4	3	4	3	5	5	5	4	4	3	4	133.5

Table V (continued)

Duties in Check-List	F	All Instructors I	D	S	C	Secretaries I	D	S	C	Instructors and Secretaries I	D	S	C	C-Score Ranks
FILING DUTIES (continued)														
File:														
98. Vouchers	5	1	6	1	2	1	5	1	2	1	6	1	2	46
99. Checks	4	1	6	1	1	1	5	1	1	1	6	1	1	39
100. Bills (invoices)	3	1	6	1	1	1	6	1	1	1	6	1	1	32
101. Receipts	3	1	7	1	2	1	7	1	1	1	7	1	1	40
102. Orders	3	2	6	1	2	2	5	2	2	2	6	2	2	50
103. Lists of various kinds	2	5	6	3	3	5	6	4	4	5	6	3	3	120
104. Cards used in filing	2	2	6	1	2	3	7	2	2	3	7	1	2	51
105. Pay rolls	6	3	5	3	4	3	3	4	3	3	5	3	3	116.5
106. Tracers	8	5	5	3	5	7	4	4	6	5	5	3	6	207
107. Passports	10	9	5	5	8	6	7	4	8	8	6	5	8	317
108. Coupons	10	6	6	4	8	5	4	4	6	6	6	4	7	278
109. Notes (financial)	7	2	4	1	2	2	5	2	3	2	4	1	2	76
110. Patent papers	9	5	4	5	6	6	5	5	7	5	4	5	6	234
111. Copyright papers	9	5	4	5	6	4	5	4	6	5	4	5	6	216
112. By-laws	5	4	4	3	4	4	4	5	4	4	4	4	4	135
113. Interviews	6	5	4	4	4	6	4	4	5	5	3	4	4	150
114. Constitutions	8	5	4	4	5	6	5	5	7	5	4	5	5	201.5
115. Expense accounts	4	2	4	2	2	2	5	5	3	2	4	3	2	62
116. Circulars	4	8	6	5	6	7	5	6	6	8	6	5	6	212
117. Tax returns	5	4	3	2	2	3	3	2	2	3	3	2	2	70.5
118. Quotations	5	4	4	4	4	5	2	3	3	4	3	3	3	114
119. Sales quotas and graphs	9	6	4	4	6	5	3	3	5	5	4	3	5	194
120. Demand loan papers	10	5	6	5	7	5	3	3	5	5	5	4	6	235
121. Credit inquiries	7	4	3	3	4	6	3	3	4	5	3	3	4	141
122. Articles of incorporation	8	4	4	4	5	4	4	4	4	4	3	4	4	159
123. Shipping orders	7	4	6	2	4	3	3	4	3	4	5	2	4	132
124. Bills of lading	6	3	6	1	2	4	4	2	3	3	6	1	3	93.5
125. Catalogs	5	4	6	2	3	8	5	4	5	5	6	2	4	130
126. Pamphlets	5	5	6	2	4	8	5	5	6	6	6	3	4	151
127. Blue prints	6	4	5	4	5	4	5	4	4	4	5	4	5	164.5
128. Magazines	6	9	7	6	7	9	6	5	7	9	7	6	7	284
129. Drawings	7	6	4	3	5	5	6	6	6	5	5	4	5	186
DUTIES CONNECTED WITH FILING, INDEXING, ETC.														
130. Take care of library	7	8	1	5	4	6	1	1	2	7	1	3	3	103.5
131. Keep follow-up files of letters not answered	3	1	3	1	1	1	8	1	1	1	5	1	1	18
Keep card indexes or other records of:														
132. Addresses	1	1	8	3	1	1	9	2	1	1	9	2	1	37
133. Telephone numbers	2	2	9	6	4	2	9	6	4	2	9	6	4	139
134. Calling list	6	6	8	8	7	7	8	9	9	6	8	9	8	302
135. Invitation lists	6	8	9	9	9	9	7	10	9	9	8	9	9	348.5
136. Gift lists	7	10	9	10	10	10	8	9	10	10	9	10	10	393
137. Christmas, birthday, etc., lists (cards)	5	10	9	10	10	9	7	9	9	10	8	10	10	374
138. Correspondents	3	4	7	2	3	3	6	5	3	3	7	2	3	107
139. Prospects	4	1	7	2	2	2	4	5	3	1	6	2	2	55.5
140. Customers	4	1	6	2	2	2	5	5	3	2	6	3	2	81
141. Clients	6	2	6	4	4	3	4	7	4	2	6	5	4	157
142. Patients	9	3	7	4	6	3	7	5	6	3	7	4	6	220
143. Parishioners	10	5	6	6	9	5	5	7	8	5	6	6	9	332
144. Contributions and charity	6	6	7	6	7	4	7	7	6	5	7	7	6	243
145. Policyholders	8	3	4	4	5	3	5	6	6	3	4	4	5	180
146. Equipment	6	4	6	5	5	7	6	4	6	5	6	5	5	197
147. Investments	6	3	2	5	3	2	3	3	2	2	2	4	3	90.5
148. Quotations of prices	5	4	4	4	4	2	3	3	2	4	3	4	3	105.5
149. Legal documents	6	2	2	2	2	2	3	2	2	2	2	2	2	53
150. Call-up (tickler systems of various kinds)	6	2	6	2	3	3	2	1	1	3	4	1	2	74

Table V (continued)

Duties in Check-List	F	All Instructors I	D	S	C	Secretaries I	D	S	C	Instructors and Secretaries I	D	S	C	C-Score Ranks
DUTIES CONNECTED WITH FILING, INDEXING, ETC. (continued)														
Keep card indexes or other records of:														
151. Install filing system	3	1	1	1	1	1	1	1	1	1	1	1	1	4
152. Revise files	2	1	1	1	1	2	1	1	1	1	1	1	1	6
153. Transfer files	2	1	2	1	1	2	2	1	1	1	2	1	1	9
154. Make folders and folder titles for files (labels)	1	2	9	1	2	5	9	1	2	3	9	1	2	52
155. Assign file numbers	4	3	7	1	3	7	8	2	5	4	7	1	3	109.5
156. Keep clipping file (newspapers, magazines, etc.)	3	7	8	5	6	7	7	3	5	7	8	4	5	201.5
157. Keep clipping books	5	8	8	6	8	9	7	5	7	9	8	6	8	289
158. Keep letter copy book	7	9	9	7	9	9	7	7	9	10	8	7	9	347
159. Keep daily reminder	2	2	9	3	3	1	9	4	2	1	9	3	3	87
160. Sort material for filing	1	3	6	1	1	3	3	1	1	3	3	1	1	16
161. Get material from files	1	3	7	1	1	5	7	2	2	3	8	1	2	41
162. Keep contemplated work files	3	5	6	3	4	7	5	4	4	6	6	4	4	142.5
163. Keep day book	5	6	8	6	6	9	8	3	7	7	8	5	7	268
164. Keep diary	6	9	8	8	9	9	8	9	9	10	8	9	9	357
165. Keep records on calendars (month, year, five-year, etc.)	3	8	8	8	8	6	7	5	5	8	8	8	7	281
TELEPHONES, ETC.														
166. Use of telephone (local)	1	1	9	2	1	2	9	2	1	1	9	3	1	25
167. Use of telephone (long distance)	1	1	8	2	1	3	9	3	2	1	9	2	1	36
168. Answer telephone	1	1	9	2	1	2	9	1	1	1	9	1	1	15
169. Send telegrams	1	1	7	1	1	2	9	1	1	1	8	1	1	12
170. Receive telegrams	1	3	9	2	2	4	9	7	5	4	9	3	3	101
171. Send cablegrams	4	4	5	1	2	5	8	1	4	4	7	1	3	88.5
172. Receive cablegrams	4	5	8	3	5	7	9	7	8	6	8	5	6	231.5
173. De-code telegrams	7	3	2	3	2	3	7	3	4	3	3	2	3	83.5
174. De-code cablegrams	7	4	2	3	3	3	6	5	6	4	3	4	4	128.5
175. Relieve on telephone switchboard	4	9	7	8	8	9	6	3	6	9	7	7	8	294
176. Turn telephone calls over to another department	2	5	8	5	5	8	9	8	7	6	9	6	6	209
177. Code telegrams	7	3	2	4	3	4	7	4	5	3	3	4	3	112
178. Code cablegrams	7	4	2	4	3	5	5	5	6	4	2	4	4	136.5
179. Receive telegram over telephone	2	2	9	5	4	3	9	6	4	2	9	5	4	140
180. Send telegram over telephone	2	2	9	4	3	4	9	5	4	3	9	4	4	124.5
181. Send telegrams by means of call box	3	7	7	8	6	7	9	7	7	7	8	8	7	249
182. Take dictation over telephone	2	3	1	5	1	3	5	6	3	3	2	5	2	49
183. Figure cost of telegrams, long distance calls, night and day letters, etc.	5	7	4	2	4	6	3	1	3	7	4	2	4	124.5
184. Send radiograms	9	6	4	5	6	8	7	3	7	7	5	4	7	259.5
185. Receive radiograms	9	7	6	7	8	8	7	5	8	7	7	7	9	330.5
DUTIES INVOLVED IN MEETING AND HANDLING PEOPLE														
186. Meet callers	1	1	1	1	1	1	2	1	1	1	1	1	1	2
187. Hear complaints in office and over telephone	2	1	1	6	1	1	1	5	1	1	1	6	1	17
188. Make adjustments of complaints	3	1	1	3	1	1	1	5	1	1	1	3	1	7
189. Hire employes	5	7	1	6	3	1	1	7	2	4	1	6	2	78
190. Discharge employes	7	9	1	7	5	2	1	8	3	7	1	8	4	160
191. Make engagements and appointments	1	1	7	4	2	2	7	2	1	1	7	3	2	48
192. Consult with attorney, tax-examiner, auditor, etc.	5	5	1	7	4	3	1	5	2	4	1	7	3	103.5
193. Interview applicants for employment	4	4	1	6	2	2	1	3	1	3	1	5	2	59.5
194. Interview gardeners, chauffeurs, etc.	8	10	8	10	10	9	4	9	9	10	7	10	10	390
195. Direct people to proper office or department	1	4	9	7	5	7	9	9	8	4	9	8	6	208

Table V (continued)

Duties in Check-List	F	All Instructors I	D	S	C	Secretaries I	D	S	C	Instructors and Secretaries I	D	S	C	C-Score Ranks
DUTIES INVOLVED IN MEETING AND HANDLING PEOPLE (continued)														
196. Attend meetings, conventions, banquets, etc.	4	9	8	8	8	7	8	8	8	9	8	8	8	305
197. Get rid of cranks and beggars	2	4	2	8	3	3	1	5	1	4	2	7	3	88.5
198. Travel to make investigations of various kinds	8	10	3	10	9	5	2	8	6	9	2	9	8	300
199. Give talks and lectures of various kinds	10	9	1	4	6	3	1	2	2	8	1	3	4	154
200. Select and invite speakers	9	8	1	8	7	6	1	5	5	7	1	8	7	250.5
201. Arrange itineraries for speakers, salesmen, etc.	9	4	1	3	4	2	2	4	3	3	1	3	3	121
202. Interview applicants for entrance to schools, clubs, organizations, etc.	7	5	5	7	6	5	2	5	4	5	3	6	5	194
203. Give information in response to verbal inquiries	2	3	5	6	3	1	5	4	1	2	5	6	2	67
204. Help place people in positions outside the organization, firm, etc.	6	10	1	10	8	9	2	9	7	10	2	10	8	304
205. Interview salesmen	4	6	6	9	7	2	4	6	3	4	6	8	6	211
206. Make arrangements for guests and visitors (hotel, entertainment, etc.)	5	7	8	7	7	3	7	6	5	5	8	7	6	238.5
207. Act as guide to visitors	5	8	8	8	8	8	5	7	7	8	7	8	8	292.5
208. Address a meeting of employes	10	8	1	8	8	6	1	9	6	8	1	9	7	280
209. Take part in employes' functions	6	5	7	9	8	3	7	8	6	5	7	9	7	276
210. Act on committees	6	5	5	8	6	5	4	6	5	5	5	8	6	226.5
211. Conference with employes	9	7	4	7	7	6	2	8	7	7	3	8	7	272
212. Call stockholders' meeting	9	7	8	7	9	5	9	4	8	6	9	6	8	323.5
213. Attend buyers', salesmen's meetings	10	9	8	10	10	4	9	7	9	8	8	9	10	381
214. Follow up written notices for meetings by telephone	4	3	8	7	5	4	9	6	6	4	8	7	6	215
215. Attend faculty, club, society, etc., meetings	7	8	9	10	10	10	5	8	9	9	9	10	10	368
216. Act as hostess at parties	8	10	6	8	9	10	2	6	7	10	4	8	9	343.5
217. Arrange for proxies for stockholders' meetings	8	6	6	5	7	2	6	2	4	5	6	4	6	210
218. Act for employer on committees	9	6	1	10	8	5	1	10	7	6	1	10	7	277
219. Organize clubs, welfare work, etc.	10	10	1	7	9	6	1	8	6	9	1	8	8	296
220. Assist in plans for entertainments, receptions, dinners, etc.	6	8	3	9	7	7	2	7	6	8	3	8	6	240.5
221. Round up people for meetings	4	5	7	9	7	4	7	7	6	5	7	9	6	229
222. Help with campaigns of various kinds	6	7	3	8	6	7	5	8	7	7	3	8	6	240.5
223. Organize committees	10	7	2	7	8	5	1	6	6	6	2	7	7	262
224. Attend commencements, lectures, etc.	5	10	9	10	10	10	8	8	9	10	8	9	10	370
225. Secure signers for petitions of various kinds	9	10	8	10	10	9	5	9	9	10	7	9	10	384
226. Render decisions on questions asked by members of office force	4	4	1	9	3	3	4	7	3	3	1	8	3	99.5
227. Confer with employer	2	1	5	7	2	2	2	4	1	1	4	6	2	65
228. Plan work for one's self	1	1	1	1	1	1	2	2	1	1	1	2	1	5
229. Plan work for others	3	2	1	2	1	1	1	2	1	1	1	2	1	11
230. Distribute work among other employes	3	2	1	6	2	1	1	3	1	2	1	5	1	35
231. Supervise other employes	3	3	1	6	1	2	1	3	1	2	1	5	1	28
232. Give orders to workmen (carpenter, electrician, etc.)	4	6	4	9	6	7	6	10	8	6	5	10	7	266.5
233. Check up employes' function sheet	10	5	4	8	7	8	8	9	10	7	5	8	9	330.5
234. Handle bundle boys, messengers, etc.	5	5	6	9	7	7	6	7	7	6	6	9	7	264.5
235. Supervise girls' club, lunch room, etc.	10	9	2	9	9	9	4	10	10	9	3	9	9	358
236. Oversee workmen	9	10	3	10	9	10	7	10	10	10	4	10	10	376.5
237. Oversee female employes and their requirements	9	7	3	9	8	7	5	8	8	7	4	9	8	297

Table V (continued)

Duties in Check-List	F	All Instructors I	D	S	C	Secretaries I	D	S	C	Instructors and Secretaries I	D	S	C	C-Score Ranks
DUTIES INVOLVED IN MEETING AND HANDLING PEOPLE (continued)														
238. Arrange lunch hours for employes, also vacations	6	7	5	9	8	6	5	9	8	7	5	9	8	298
239. Check up on unfinished work of other employes	5	3	3	8	4	3	3	8	5	3	3	8	4	144
240. Give directions for work to be done	3	2	2	5	2	1	2	4	1	2	2	4	2	43.5
241. Perform first-aid relief	7	7	2	4	5	9	2	7	7	8	2	5	5	191
242. Act in advisory capacity to students, employes, etc.	7	6	1	9	5	4	1	7	3	5	1	8	5	171
243. Organize office	6	2	1	1	1	1	1	1	1	1	1	1	1	13
244. Manage office	4	2	1	2	1	1	1	1	1	1	1	1	1	8
245. Oversee employer's servants	9	10	4	10	10	10	5	10	10	10	5	10	10	387
246. Decide on priority of work	4	4	2	6	3	1	2	8	3	3	2	7	3	102
247. Record late employes	8	8	8	9	9	9	8	9	10	9	8	9	9	359
248. Instruct new employes	3	2	1	5	2	1	2	3	1	1	1	4	1	26
249. Teach training class of employes	10	7	1	7	6	7	1	3	5	7	1	6	6	213
250. Issue permits for various things	7	9	7	8	9	7	7	8	8	8	7	8	9	326.5
251. Countersign employes' charge purchases, permits, etc.	8	6	8	9	9	8	6	7	8	7	8	8	9	328.5
252. Greet employes	5	5	10	8	8	7	7	6	7	6	9	7	8	295
253. Reprimand employes	7	9	1	9	7	7	1	4	5	9	1	8	6	222
254. O. K. passes, etc.	8	8	9	10	10	9	8	7	10	8	9	9	9	364
255. Investigate references, personal, and financial	6	3	3	5	3	2	2	3	2	2	2	4	3	82
256. Keep employer reminded of engagements, dates, things to do, etc.	2	1	8	5	2	1	9	5	2	1	8	5	2	54
257. Keep employer in touch with office events, personnel, etc.	2	1	8	7	3	1	7	7	2	1	8	7	3	105.5
258. Investigate causes of trouble between employes	8	6	1	10	6	5	2	7	5	5	1	9	6	214
259. Counteract false reports which spread in an organization	6	4	1	8	4	2	1	8	3	3	1	8	4	133.5
260. Investigate appeals for charity	8	8	5	9	8	7	2	8	7	8	4	9	8	303
261. Handle compensation (insurance)	8	5	1	5	4	3	1	2	2	4	1	3	3	96.5
262. Handle beneficiaries in charity cases	10	8	1	7	7	5	2	4	6	7	1	6	7	271
263. Do case work involved in workmen's compensation	10	7	1	8	7	6	1	8	6	7	1	8	7	257
264. Settle claims for damages, injuries, losses, etc.	10	8	1	6	7	4	2	5	5	7	1	6	7	244.5
CLERICAL DUTIES														
265. Place telephone memoranda, messages, etc., where employer will see them	1	1	10	4	2	1	9	8	3	1	10	6	2	64
266. Keep current date on calendars visible	1	2	10	8	5	3	9	7	5	2	10	8	5	188.5
267. Order supplies of various kinds for office	1	1	9	5	2	4	8	7	3	2	9	5	2	69
268. Get quotations on supplies	2	2	8	5	4	4	8	8	6	2	8	6	4	142.5
269. Check up on supplies	2	1	9	5	3	3	8	8	5	2	9	6	4	126
270. Take inventory	3	2	2	2	1	3	2	5	2	2	2	2	1	29.5
271. Make out requisitions	2	1	7	2	2	6	8	3	4	2	8	2	2	73
272. Approve requisitions made out by clerks	5	3	7	7	5	5	7	9	8	3	7	8	6	219
273. Arrange papers on desk	1	3	10	5	5	7	9	8	7	4	10	6	5	185
274. Anticipate needs of employer as to records, papers, etc., needed on trips, for interview, etc.	2	1	3	7	1	1	5	7	2	1	4	7	2	45
275. Make out itinerary or schedule for employer's trips	5	2	1	2	1	1	3	2	1	1	2	2	1	23
276. Keep desks supplied with equipment	1	1	10	6	4	2	9	9	6	2	10	7	4	155

Table V (continued)

Duties in Check-List	F	All Instructors I	D	S	C	Secretaries I	D	S	C	Instructors and Secretaries I	D	S	C	C-Score Ranks
CLERICAL DUTIES (continued)														
277. Make out shipping instructions	5	6	4	3	4	6	2	2	2	6	3	2	3	118
278. Fill out tracers for mail, express, etc.	5	6	4	6	5	8	3	2	4	7	4	5	5	181
279. Route shipments of material (traffic work of various kinds)	8	5	2	4	4	7	2	6	6	6	2	5	5	173
280. Place articles on desk in order	2	4	10	7	6	7	10	10	9	5	10	8	7	257
281. Check orders	4	2	7	5	4	4	7	6	5	3	8	5	5	166
282. Revise stock list	7	6	6	6	6	7	2	6	6	6	5	6	6	231.5
283. Check remittances as to amounts, dates, and signatures	4	2	7	2	3	1	7	7	4	1	7	3	3	99.5
284. Send amendments to patent office	10	7	4	6	8	10	4	7	9	8	3	7	8	309
285. Make arrangements for radio schedule	10	8	5	8	10	8	5	9	10	8	5	9	10	373
286. Check tally sheets on various jobs	10	6	7	7	8	6	8	7	9	6	7	7	9	325
287. Make arrangements for freight, express, etc.	5	5	7	7	6	9	8	5	8	7	7	6	7	255
288. Notify judges of election	10	8	9	9	10	10	9	10	10	9	9	9	10	396
289. Notify directors of election	8	7	9	9	9	10	9	9	10	8	9	9	9	361
290. Take care of signed proxies	7	7	7	8	8	3	7	7	7	6	7	8	8	287
291. Make preparations for annual meetings	6	5	3	9	5	2	2	7	4	4	2	9	5	179
292. Send Board of Committees notices	5	6	8	8	7	2	8	3	4	4	8	6	6	238.5
293. Act as notary public	8	6	4	8	7	5	7	2	6	6	5	6	7	262
294. Make out day's schedule for employer	7	5	6	7	7	3	4	3	3	4	6	6	6	218
295. Place daily newspapers, magazines, etc., on employer's desk	3	10	10	10	10	10	10	10	10	10	10	10	10	389
296. Check up questionnaires	5	10	6	9	8	7	6	9	8	9	6	9	8	308
297. Check personnel of committees	6	8	7	10	9	7	7	8	8	8	7	9	8	318.5
298. Look up names and addresses	1	5	9	6	5	9	9	8	8	7	9	7	6	229
299. Renew magazine subscriptions	3	9	10	9	9	10	9	8	10	10	10	9	9	362
300. Deliver policies	9	8	9	9	10	9	9	9	10	9	9	9	10	378
301. Look up patents for reference in Patent Office Gazette	10	8	3	8	9	9	5	4	9	8	3	7	9	343.5
302. Change dates on rubber stamps daily	4	4	10	8	7	8	10	9	9	6	10	9	8	318.5
303. Look over notes and memos for the day	2	2	9	8	5	3	9	7	6	2	9	8	5	187
304. Compile periodical reports	5	7	2	3	3	4	1	3	2	6	1	3	3	83.5
305. Assemble mimeographed material	4	5	9	4	6	9	9	5	8	7	9	4	6	237
306. Compare copy	3	6	6	3	4	7	8	4	5	6	7	3	4	153
307. Post notes (notices)	5	7	9	8	8	10	9	7	9	9	9	8	9	335.5
308. Record daily shipments	8	8	9	8	9	6	8	7	8	8	8	7	9	335.5
309. Get information from various departments needed for correspondence	3	2	5	8	3	2	5	5	3	2	5	7	3	109.5
310. Inspect material received	5	4	6	8	6	4	7	9	7	4	7	9	6	233
311. Rule reports	7	8	7	6	8	9	6	5	8	9	7	6	8	306
312. Keep records on maps (sales records, etc.)	8	8	4	7	8	3	4	4	5	7	4	6	7	266.5
313. Make headings for monthly statements	7	9	8	5	8	8	7	2	6	9	8	4	8	285.5
314. Make out accident reports	6	8	5	7	7	8	4	3	5	8	5	6	7	253
315. Keep record of territory assigned salesmen	8	5	7	7	7	3	6	4	5	4	7	6	7	252
316. Operate adding machine	2	1	6	1	1	5	8	1	2	2	7	1	1	20
317. Operate mimeograph	4	1	2	1	1	7	5	1	3	2	2	1	1	19
318. Operate comptometer	6	2	1	1	1	7	2	1	2	3	1	1	1	22
319. Operate addressograph	7	2	3	1	2	9	5	1	4	4	3	1	2	66
320. Operate duplicating machine	7	1	3	1	2	8	2	1	4	3	3	1	2	58
321. Prepare agenda for meetings	6	4	4	5	5	4	3	3	3	4	4	5	5	188
322. Have legal papers recorded	7	3	7	5	5	2	7	2	3	2	7	3	4	156
323. Secure prothonotary certificate	9	7	7	9	9	8	3	4	6	8	6	7	8	322
324. Sort advertisements to keep out fraudulent ones	9	9	5	7	8	8	5	5	8	9	5	7	8	310
325. Keep records of time and time cards	7	5	7	4	5	7	8	7	8	5	7	5	6	236
326. Keep tonnage sheets	9	8	7	7	9	9	3	9	9	9	6	8	9	348.5
327. Keep office instruction book for employes	9	6	5	6	7	6	8	8	9	6	6	7	8	290
328. Apply for automobile and driver's license	5	9	8	10	9	7	10	8	9	8	9	9	9	345

Table V (continued)

Duties in Check-List	F	All Instructors I	D	S	C	Secretaries I	D	S	C	Instructors and Secretaries I	D	S	C	C-Score Ranks
CLERICAL DUTIES (continued)														
329. Make out grades	8	8	3	10	8	8	7	7	8	8	5	9	8	312
330. Make notes for next day's work	2	3	7	6	4	4	8	5	5	3	8	6	5	163
331. Review unfinished business file	4	4	8	6	5	3	7	4	4	4	8	6	5	182
332. Distribute supplies	4	9	9	9	9	10	9	9	9	9	9	9	9	352
333. Write letters not dictated (i.e., compose letters)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
334. Dictate to a dictaphone	9	5	2	1	3	5	1	1	2	5	2	1	3	96.5
335. Take dictation from a dictaphone	8	2	2	1	1	5	2	1	1	3	2	1	1	29.5
336. Check up on observance of various laws (in connection with work)	8	7	1	7	6	6	2	6	5	6	2	7	6	204.5
337. Zone territory for various purposes	10	8	2	7	8	7	1	4	6	8	2	6	7	282
338. Do work involving government duties, customs, tariff regulations, etc.	9	9	1	6	6	6	1	3	3	8	1	5	6	204.5
339. Secure government permits of various kinds	9	8	2	7	6	7	3	6	7	7	2	7	6	222
340. Keep daily attendance of employes	7	7	9	9	9	6	6	7	7	7	8	8	8	315
341. Make letter press copies of letters	8	10	9	6	9	9	6	6	9	10	8	6	9	350
MISCELLANEOUS DUTIES AND PERSONAL SERVICES FOR EMPLOYER														
342. Make hotel reservations	2	3	9	6	5	2	10	6	5	3	9	6	5	177
343. Make train reservations	2	4	8	5	5	1	9	6	4	2	9	5	4	162
344. Make steamship reservations	6	5	8	6	7	1	8	5	5	4	8	6	6	226.5
345. Apply for passports for employer	8	6	4	7	7	2	7	7	6	4	5	7	7	244.5
346. Dust	1	10	10	9	9	9	10	10	10	10	10	10	10	372
347. Clean and oil typewriter	1	2	9	1	1	5	10	1	3	3	10	1	1	38
348. Wind clock	3	9	10	10	10	10	10	10	10	9	10	10	10	391
349. Take care of flowers	2	9	10	10	10	10	10	10	10	10	10	10	10	398
350. Purchase flowers, fruit, books, gifts, etc.	3	10	10	10	10	9	9	10	9	10	10	10	10	383
351. Get theater, opera, concert, lecture tickets for employer	3	9	10	10	10	7	10	10	9	9	10	10	9	360
352. Make hospital reservations	8	9	9	10	10	9	10	10	10	9	10	10	10	394
353. Make arrangements for consultation	4	4	8	9	6	4	10	8	7	4	9	9	7	259.5
354. Assist with laboratory work	9	9	6	7	9	7	2	7	7	8	4	8	8	321
355. Shave dictaphone cylinders	9	8	8	1	7	9	9	2	8	9	9	1	8	292.5
356. Errands	2	9	10	9	9	9	9	9	8	9	9	9	9	337
357. Help with decorations at conventions	8	10	8	10	10	10	8	10	10	10	8	10	10	400
358. Keep stock of employer's personal stationery, cards, greetings, etc., on hand	4	7	9	8	8	4	10	10	9	6	9	10	8	316
359. Send out Christmas cards for employer	4	10	10	10	10	7	10	10	10	9	10	10	10	386
360. Purchase Christmas cards, Valentines, birthday cards, etc., for employer	5	10	9	10	10	9	9	10	10	10	9	10	10	397
361. Collect foreign stamps	7	10	8	10	10	10	9	10	10	10	9	10	10	404
362. Keep personal diary for employer	8	10	7	10	10	10	4	10	10	10	7	10	10	395
363. Keep book of activities, trips, honors, degrees, clubs for employer	7	9	7	9	9	9	8	10	10	9	7	9	9	355
364. Arrange physical layout of office pictures, draperies, etc.	4	10	5	7	8	8	2	5	4	9	4	7	7	248
365. Prepare exhibits for art galleries	10	10	5	10	10	9	4	8	9	10	4	10	10	392
366. Advise employer of illnesses, deaths, births, weddings, trips, etc., of friends	5	8	7	9	8	7	8	10	9	8	7	10	9	338
367. Keep kodak albums	10	10	9	10	10	10	9	10	10	10	9	10	10	406
368. Contract with interior decorator for draperies in reception office	9	10	6	10	10	8	2	8	8	10	5	9	10	380
369. Select furnishings for office	5	9	2	8	6	2	1	3	1	7	2	7	5	171
370. Report on repairs and upkeep of office	3	6	7	9	7	3	5	5	4	5	7	8	6	217
371. Get magazine subscriptions	6	9	8	9	9	10	8	9	10	10	8	9	10	367
372. Sharpen pencils	1	9	10	8	8	10	10	10	10	10	10	9	9	342

Table V (continued)

Duties in Check-List	F	All Instructors I	All Instructors D	All Instructors S	All Instructors C	Secretaries I	Secretaries D	Secretaries S	Secretaries C	Instructors and Secretaries I	Instructors and Secretaries D	Instructors and Secretaries S	Instructors and Secretaries C	C-Score Ranks
MICELLANEOUS DUTIES AND PERSONAL SERVICES FOR EMPLOYER (continued)														
373. Straighten up office	1	7	10	8	7	9	10	9	8	8	10	8	8	299
374. Make charts	6	8	4	4	5	7	2	1	3	8	3	2	4	148
375. Make tracings for blue prints	9	9	2	7	7	9	2	5	7	9	2	7	7	279
376. Make blue prints	10	9	2	6	8	9	2	7	9	10	2	6	9	334
377. Trace maps	9	9	5	7	9	8	5	2	7	9	6	6	8	323.5
378. Make arrangements for repairs on employer's property (automobile, etc.)	6	10	8	9	10	8	7	10	9	9	8	10	9	363
379. Examine food for dining room (club or hotel)	10	10	8	10	10	9	7	9	10	10	8	10	10	401
380. Wind and change dial on watchman's time clock	10	9	9	10	10	10	9	9	10	10	9	10	10	399
381. Shop for employer	3	10	5	10	9	9	3	10	7	10	4	10	9	328.5
382. Cut stencils	4	1	2	1	1	5	7	1	2	2	3	1	1	14
383. Design letterheads for stationery	6	6	1	3	3	7	5	2	5	6	2	3	3	116.5
384. Send invitations	4	8	7	4	6	6	8	2	4	7	8	3	5	197
385. Acknowledge invitations	3	5	7	2	3	3	8	1	3	4	8	2	3	115
386. Write letters of condolence and congratulation	3	6	2	2	2	5	1	1	1	5	2	1	2	43.5
387. Acknowledge letters of condolence and congratulation	4	6	3	2	3	4	2	1	1	5	2	1	2	59.5
388. Write suitable cards to accompany gifts, flowers, etc., sent by employer	6	8	6	5	6	2	2	2	1	6	4	3	5	164.5
389. Secure list of poor to whom things should be sent	9	10	7	10	10	8	5	10	9	10	7	10	10	385
390. Note tax laws in newspapers	7	8	5	8	8	4	3	5	4	7	4	7	7	250.5
391. Keep in touch with legislative activity that bears on work	7	2	2	6	3	1	2	5	2	1	2	6	3	90.5
392. Visit factories	9	10	8	9	10	7	5	8	8	10	8	9	10	375
393. Open desks and safes	3	7	10	10	9	5	9	9	7	6	10	10	8	313.5
394. Lock desks and safes	2	5	10	9	8	3	9	9	6	4	10	9	7	273
395. "Drum up trade"	8	10	2	8	8	6	1	7	5	9	2	8	7	274.5
396. Wait on customers	5	5	6	6	5	3	3	2	2	5	5	4	4	161
397. Prepare and keep up abstract book with abstracts and reprints of speeches, hints for speeches, data figures, illustrations, etc.	9	6	2	5	5	5	1	2	3	5	2	4	5	178
398. Distribute theater tickets	8	10	10	10	10	9	9	10	10	10	10	10	10	403
399. Give gas to dental patients	10	10	2	9	10	4	2	10	9	8	2	10	10	371
400. Take X-ray pictures	10	9	1	9	9	7	2	8	9	9	1	8	9	346
401. Arrange for disposal of worn-out equipment	8	9	6	9	9	9	5	10	9	9	6	10	9	356
402. Call taxis	3	8	10	10	9	10	10	10	10	9	10	10	9	365
403. Dress windows	10	9	2	7	9	9	1	5	8	9	1	7	9	340
404. Collect money from office employes for various purposes	5	10	8	10	10	9	6	8	8	10	8	9	9	351
405. Give testimony in lawsuits	10	9	3	8	9	6	2	7	7	8	2	8	9	326.5
406. Decide on continuance of sick benefit	10	10	4	10	10	8	2	9	10	9	3	10	10	388

THE RELATIVE IMPORTANCE OF ITEMS OF CHEMICAL INFORMATION FOR GENERAL EDUCATION[1]

by
Robert P. Wray

INTRODUCTION

An understanding of the title of this article demands an explanation of some of the terms involved. By "general education" is meant, "that portion of the training, both fundamental and functional, which is of general need, whatever be one's occupation or station in life...."[2] Brief mention should be made of "utility" and "relative utility" as criteria in curriculum construction. It is held that not only should the curriculum be modified in order to retain that which is useful, but at the same time materials and methods should be selected which will yield the greatest returns within the scope of the school.[3]

It is the purpose of this study to avoid the conventional approach dominated by specialism, the theory that the content should come from the specialist and be applied by the individual to the activities in which he engages after he has learned them. The domination of the secondary school offerings by subject specialists has resulted in a confused bulk of subject matter.

In the recent Thirty-First Yearbook of the N. S. S. E.,[4] Professor Powers gives an excellent discussion of the present situation in regard to the chemistry curriculum, and then goes on to point out that:

> "The question of functional values for the special subjects has not been seriously studied and this level defines a field for fruitful curriculum research. Specialists in science have contributed enormously to determining the character of our present civilization, and they have contributed enormously to a fuller interpretation of the phenomena of everyday experiences that challenge the interests of liberally educated people. These considerations suggest the turn that curriculum research on this level must take. Studies of the interests of children and the interests of "educated laymen" have served as a proper approach in the determination of the functional content, but they are inadequate in that they do not go deeply enough. The services of those who have explored more thoroughly into the fields must be enlisted."[5]

Chancellor Capen clarifies the concept of the "functional study" in the introduction he has written to the Commonwealth Teacher-Training Study.

> "A functional study tries to determine what the professional practitioner does under modern conditions of practice. From the objective record of what he does it attempts to derive the determination of what he must be to perform these duties efficiently. The functional study, if complete, should determine the technical knowledge and skill actually used by the practitioner. It should give helpful guidance in the determination of the general non-technical knowledge that the practitioner should possess."[6]

MEASURES OF RELATIVE UTILITY

Chemical information may have many forms of utility, such as use in various occupations and professions, giving pleasures of recognition and interpretation, reading and conversation, domestic activities, health, etc. But regardless of the form, certain tests of relative utility may be applied. Peters has suggested four:[7]

1. Frequency of Occurrence. In the first place, other things being equal, that which is relatively most useful is that which promises to function most frequently in the life of the pupil.

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1. Doctor's Dissertation, The Pennsylvania State College, 1932.
2. Franklin Bobbitt, How to Make a Curriculum (New York: Houghton Mifflin Company, 1924), p. 66.
3. C. C. Peters, Foundations of Educational Sociology (New York: The Macmillan Company, 1932), pp. 54-55.
4. S. R. Powers, Thirty-First Yearbook of the National Society for the Study of Education, Part I, A Program for Teaching Science (Bloomington, Illinois: Public School Publishing Company, 1932), pp. 24-26.
5. S. R. Powers, ibid., p. 26.
6. S. P. Capen, Commonwealth Teacher-Training Study (Chicago: The University of Chicago Press, 1929) p. xvi.
7. C. C. Peters, Op. cit., pp. 60-65.

2. Cruciality. In the second place, that which is relatively the most useful is that which gives promise of entering as a factor into the most critical adjustments.

3. Many-sidedness. That which is relatively most useful, other variables held constant, is that which is most applicable and integrating in character.

4. Person Appeal. Finally, that which is relatively most important, other things being equal, is that which can make the strongest personal appeal to the learner. This is related to the interest the material holds for the pupil as a learner, and the extent to which the information promises to be satisfying and enriching to the individual.

As tests of the relative utility of items of information, frequency of occurrence and many-sidedness are quite similar. It will usually be true that that which has many ways of application will have a rather high frequency in use. The two tests are so similar that in the present study it seemed satisfactory to consider that the estimates of frequency would give sufficient evidence concerning many-sidedness.

In regard to cruciality and personal appeal, the overlapping is not so great. This study has asked for evaluations concerning the pleasure or satisfaction that it gives one when he meets the item in his experience. It cannot be claimed that this will bear a definite relationship to the cruciality values of the items, although the two tests seem to have certain points in common. Probably it would be better to get estimates of the "advantage" of each item in the lives of individuals. This would involve both cruciality and personal appeal. Be that as it may, the study here reported has relied upon estimates of "frequency of occurrence" and "pleasure or satisfaction" in arriving at "index values" indicative of the relative utility of the items of chemical information evaluated by the respondents.

It is the problem of this study to determine the relative importance of the items of chemical information that are included in a course in general chemistry. The "index values" that have been determined indicate one measure of the relative usefulness of the items in the lives of laymen who have studied at least one year of high-school chemistry. Such evaluations become of significance in the reorganization of the chemistry course when the curriculum worker, be he teacher, supervisor, or research specialist, becomes concerned to make the chemistry course supply information which will function as largely as possible in the lives of the students. This problem becomes increasingly important when one considers the needs of the large number of students whose science training will end with their first course in chemistry. The question of supplying functional values for chemistry is still more important when, as can be pointed out,[1] the earlier objectives --formal discipline, knowledge, and college preparation--are not any longer valid.

The problem described here attempts an analysis of practically all of the items of information that one would be tempted to include in an elementary course in chemistry. The policy of evaluating information now contained in traditional textbooks does not make any provision for the inclusion of new materials, excepting as supplementary information is recognized to exist and is woven into the course at appropriate points by curriculum constructors. At a later date, this new material should be exposed to the same type of evaluation. The business of asking for indexes of usefulness concerning information already known is superior, for our purpose, to asking for estimates of what the respondent would like to know about chemistry. It is practically impossible to get a worth-while response from anyone about that which he knows nothing. This is not to be taken as a criticism of the technique of building curricula around children's questions. Such a procedure has pertinent use at the elementary school level, and has value as a method of presenting materials of instruction at any plane.

Whatever may be said against the use of questionnaires, the fact remains that certain types of information can be had only by asking for direct testimony from the

1. S. R. Powers, Op. cit., pp. 24-26.

individuals concerned. Such is the demand of the present problem.

AIMS OF THE PROBLEM

At the beginning of the study certain aims, problems, and hypotheses were consciously present. They follow:

1. Is it possible to assign a distinctive "index value" to each item of chemical information as an indication of its relative usefulness in the lives of individuals?
   a. Will the responses be reliable?
   b. Will the "index values" be valid? Will they actually be measures of usefulness?
   c. How large a sampling of the population is necessary to give sufficient reliability so that the obtained responses may be considered an index of what the group would give?
2. Do the items of chemical information have the same or a different order of importance for all individuals, regardless of occupation, sex, or habitat?
3. May the amount or degree of usefulness vary for different groups of people, even though the relative importance of the items remains the same?
4. Are the various utilitarian forms of chemistry positively correlated?

PROCEDURE

The Technique.

The technique about to be described can best be understood by referring to a "section" of the first page of questionnaire number one.

The entire list of 1550 items, including the illustratory ones given in the following section of the first questionnaire, was taken from four chemistry texts commonly used in high schools: Bradbury, A First Book in Chemistry; Brownlee and Others, Elementary Principles of Chemistry; Fletcher, Smith, and Harrow, Beginning Chemistry; and McPherson, Henderson, and Fowler, Chemistry for Today.

Name..... Occupation.....
Address..... No. yrs. chemistry studied beyond high school.....

Following are a number of items, statements, principles, etc., which are found in a general chemistry course. You will readily recognize that these items do not all have the same value or "utility" to you. It is to ascertain this value so that we may know which items are most important and hence should be stressed more in the teaching of chemistry that this study is being made.

Will you kindly check the following items in two respects: first as to Frequency of Occurrence (that is, the relative number of times each item occurs to you in your life activities); and second, as to Pleasure, (that is, the degree of satisfaction or pleasure that it gives you to understand the item when you meet it in your experience).

Check each item in the column which most nearly represents its relative frequency and pleasure to you. If there are some items which you never learned, do not attempt to check them. FIRST, GO THROUGH ALL THE ITEMS AND CHECK THEM FOR FREQUENCY. THEN, GO THROUGH THE LIST A SECOND TIME AND CHECK THE ITEMS FOR PLEASURE.

	FREQUENCY					PLEASURE				
	Never	Occasionally	Moderate	Often	Very Often	None	Very Little	Moderate	Considerable	Great
1. Oxygen is the most abundant element in the earth's crust.										
2. Oxygen was first obtained by Priestley in 1774.										
3. Oxygen was first obtained by heating a red powder--mercuric oxide.										
4. Oxygen is usually prepared in the laboratory by heating potassium chlorate.										
5. The speeding up of some chemical reactions is aided by catalytic agents.										

The selection of the subject matter to be evaluated was done by going through the texts, one at a time, and writing down the items of information in as simple and concise a form as possible. The subjective element involved in the selection of the items excludes any positive claim for the inclusion of all possible information.

However the total list of 1550 evaluated items precludes any great omission of subject matter.

It would have been possible to add to the list a large number of items dealing with specific atomic and molecular weights, valences, equations, and problems. On the first two questionnaires used in the study some of the most common of the items of information pertinent to the above topics were included. Because there was a distinct tendency for these items to receive a low rating, it seemed wise to omit comparable statements that are even less familiar. For instance, it must be expected that statements of specific atomic weights of elements which are less well known than those of oxygen and hydrogen will tend to receive correspondingly lower ratings. Again, if equations and problems as a class are rated low in usefulness, then less familiar examples will in all probability receive ratings lower than the mean of the class. This cannot be taken to mean that such topics of information need not be taught, but that their "usefulness" is low and that some other justification must be offered for their inclusion in the course. Chemistry teachers will readily recognize the necessity for including some of this information as a basis for understanding certain chemical phenomena.

The various types of chemical information were distributed among all of the fifteen questionnaires and no attempt was made at classification of the items until after the "index values" had been derived. The directions for checking the statements of information appear at the top of the first page of each questionnaire (see specimen section shown on preceding page). The respondents were asked to indicate the relative frequency of use of each of the items by checking in the appropriate one of the columns entitled, "never", "occasionally", "moderate", "often", "very often." The amounts of the accompanying pleasure or satisfaction were indicated by checking corresponding columns under "pleasure."

Objectivity of the Technique.

Since the procedure used in this study, and described more in detail later in this article, makes use of the "method of estimates", it is fitting that evidence be introduced to show the reliability of this technique. For a long time it has been held rather in disfavor, and the casual reader is inclined to consider it too subjective for obtaining reliable and consistent results. As a matter of fact, we now have considerable evidence as to the feasibility of the use of this technique, not only in asking people for estimates as to the value of items of information in their lives, but in estimating the values of activities in the teaching profession,[1] in rating scenes from motion pictures according to a scale of values,[2] evaluating the elements of cultural education,[3] judgments upon the elements contributing to success in the Christian ministry,[4] estimating the interest value of subject matter in general psychology,[5] and in judging heights, weights, achievement and intelligence of children.[6] Only information found in the present study will be reported here. For more complete evidence see the indicated references.

The ability to make definite responses in regard to the frequency with which items of chemical information have been used, and the pleasure or satisfaction attending this use, is evidenced in the present study by the high correlation between the results obtained from two submissions of the same questionnaire to the same group. In the first

1. W. W. Charters and Douglas Waples, The Commonwealth Teacher-Training Study (Chicago, Illinois: The University of Chicago Press, 1929), pp. 28-29.
2. C. C. Peters, The Relation of Motion Pictures to Standards of Morality, New York: The Macmillan Company, 1933
3. D. W. Campbell, A Technique for Evaluating the Elements of Cultural Education by a Correlation Method, Unpublished Master's Thesis, Pennsylvania State College, 1950.
4. Mary E. Moxcey, Some Qualities Associated with Success in the Christian Ministry, Teachers College Contributions to Education, No. 122 (New York: Bureau of Publications, Teachers College, Columbia University, 1922), p. 10.
5. A. S. Lick, The Measurement of the Interest Value of Representative Items Taught in Elementary Psychology, Unpublished Master's Thesis, Pennsylvania State College, 1932.
6. James C. Swab, The Reliability and Validity of Pupil Estimates as a Measuring Tool, Unpublished Master's Thesis, Pennsylvania State College, 1932.

case a list of sixty items was checked according to the general directions by a group of 22 graduate students in education. Two weeks later, without any previous warning, they were again asked to check the items according to the original directions. The Pearson coefficient of correlation between the values obtained for the items on the two occasions was, $r = .98 \pm .008$. On another occasion, using 75 other items, a group of 38 seniors at the Pennsylvania State College checked the questionnaire. After a period of four weeks the same group responded again to the same list of items. The correlation between the results obtained from the two submissions of the same questionnaire to this group was, $r = .957 \pm .008$. These two computations seemed to indicate a high degree of consistency for the responses.

Another type of reliability is involved in the question of the reliability of the "index values." How large a group is necessary in order that the responses by one half of them agree very closely with those by the other half? That is, do the relative values assigned to the items by the groups of respondents actually represent the values which would be assigned by the entire membership of the group? Suffice it to say here that, using the results obtained from the total number of respondents on each questionnaire, the average reliability of the "index values", as shown by the coefficients of correlation between chance halves of the groups with the fifteen questionnaires used in this study was .933 with a range from .910 to .956. The total number of respondents to each of these questionnaires was approximately 100.

Distribution.

It will be recalled that one of the aims of this problem was to determine indexes of the relative utility of the items of chemical information of various occupational groups, and then to make inter-group comparisons to discover existing relationships. The questionnaires were distributed to individuals who had studied a minimum of one year of high-school chemistry. (See Tables II and III for names of groups answering the questionnaires.)

Tabulation and Treatment of Results.

The papers belonging to each group were tabulated by halves for the sake of getting reliability coefficients, and then the two halves combined to give a total for the group.

The results of the complete tabulation of the total number of responses on the first five items (the same items listed in the section of the questionnaire shown on a previous page) of questionnaire number one are shown in Table I. These results are typical of the procedure involved in the tabulation of the returns from any group or sub-group. In computing median values for the "frequency" and "pleasure" of an item, the upper limits of each of the five cells were arbitrarily given values of 1, 2, 3, 4, and 5 respectively. An "index value", indicative of the relative usefulness of an item of information, was then computed by multiplying its median frequency value by its median pleasure value.

Table I

RESULTS OF THE TABULATION OF THE TOTAL NUMBER OF RESPONSES ON THE FIRST FIVE ITEMS OF QUESTIONNAIRE NUMBER ONE

	Frequency					Pleasure							
	Never	Occasionally	Moderate	Often	Very Often	None	Very Little	Moderate	Considerable	Great	Median Frequency Value	Median Pleasure Value	"Index Value"
1.	32	40	22	33	46	20	33	58	30	39	2.68	2.74	7.34
2.	70	62	20	11	8	58	51	33	16	11	1.26	1.53	1.92
3.	74	67	21	8	5	49	42	39	23	8	1.21	1.76	1.92
4.	65	61	20	17	12	40	41	49	27	14	1.38	2.10	2.89
5.	29	50	25	50	19	29	30	40	43	27	2.32	2.65	6.14

The reason for using median values was the desire to have the rating that the midman would assign to the item. Median values are also not as sensitive as means to erratic judgments on the part of careless respondents. The values determined for "frequency" and "pleasure" are not distinct index measures of two kinds of utility. Evidence found with the second of the series of questionnaires showed that "frequency" and "pleasure" are so closely related that either might have been validly used by itself.

The relationship between the values, as indicated by the Pearson coefficients of correlation, varied from .736 to 1.000 (corrected for attenuation). As mentioned above, the two values were multipled together to give an "index value" indicative of the relative usefulness of the item of information.

Reliability of the "Index Values."

Having obtained "index values" for each of the items it was a comparatively simple matter to ascertain their reliability. These reliabilities, as indicated by the Pearson coefficient of correlation between halves of a group, are given in Tables II and III for the values obtained with questionnaires one and two respectively. Reliabilities with the other thirteen questionnaires are given later in this article in less detailed form. In order to show the extent to which the "index values" assigned by the total of a given group may be said to agree with those that would be given by another similar group the derived coefficients of correlation from the two halves have been stepped-up by the Spearman "prophecy" formula.

Table II

THE RELIABILITY OF THE "INDEX VALUES" OF THE ITEMS IN QUESTIONNAIRE NUMBER ONE

Groups	No. of Cases	r	Stepped-up
Total	176	.911	.953
Teachers	35	.782	.878
Engineers	24	.782	.877
Students	38	.755	.860
Laborers	22	.722	.838
Housekeepers	14	.702	.824
Medical Men	20	.682	.810
Secretaries	14	.658	.793
Business Men	9	.602	.751

Table III

THE RELIABILITY OF THE "INDEX VALUES" OF THE ITEMS IN QUESTIONNAIRE NUMBER TWO

Groups	No. of Cases	r	Stepped-up
Total	142	.902	.948
Pharmacists	20	.799	.889
Students	36	.765	.866
Nurses	18	.703	.825
Engineers	20	.787	.881
Laborers	14	.663	.797
Teachers	34	.648	.786

Inspection of the above tables shows the reliability of the "index values" of the items to be very high. The lowest (r = .751) is in the case of the nine business men on questionnaire one, while the highest (r = .889) comes from a group of 20 pharmacists on questionnaire two. The reliabilities given by the total number of respondents are .953 and .948 on questionnaires one and two respectively.

Inter-Group Relationships.

It was also of interest to know what relationship exists between the evaluations assigned to the items by the various groups. It was found that the average of the "index values" assigned to a certain list of items by one group of respondents differed from the index average assigned by other groups, but at the same time the relative order of preference for the items tended to be the same. Such agreement in the relative arrangement of the items is shown by the degree of correlation between the "index values" assigned by the total individuals in one group with those assigned by the total respondents in any other group. All inter-group correlations were made by using the Pearson product-moment formula. The results on questionnaires numbers one and two respectively are shown in Tables IV and V. Since the reliabilities of the "index values" assigned by the groups are not perfect, it is proper to correct the inter-group correlations for attenuation. There is a certain hazard in this practice since it must be assumed that the coefficient of correlation to be corrected is at the mean of all possible correlations between other samplings of the same groups. Granting the validity of this practice, coefficients of correlation that are corrected for attenuation are an indication of what the agreement between groups of the population would be if they had been sampled infinitely.

Examination of the following tables shows the inter-group correlations to be consistently high and positive. This tendency is even more noticeable when they are corrected for attenuation, the average inter-group correlations being raised from .751 and .710 to .896 and .849 respectively. Some groups, when their coefficients of correlation are corrected for attenuation, show

Table IV

INTER-GROUP CORRELATIONS ON QUESTIONNAIRE NUMBER ONE

Groups	r	Corrected for attenuation
H. S. Students with Teachers	.877	1.000
H. S. Students with Engineers	.870	1.000
Secretaries with Housekeepers	.946	1.000
Secretaries with Engineers	.875	1.000
Secretaries with Business Men	.760	.985
H. S. Students with Secretaries	.812	.984
Teachers with Housekeepers	.825	.970
Teachers with Laborers	.806	.940
Housekeepers with Business Men	.738	.938
Teachers with Medical Men	.777	.921
Teachers with Secretaries	.768	.920
H. S. Students with Medical Men	.758	.907
Laborers with Engineers	.778	.907
H. S. Students with Housekeepers	.762	.906
Housekeepers with Laborers	.750	.903
Laborers with Medical Men	.741	.900
Medical Men with Engineers	.758	.900
Secretaries with Laborers	.731	.896
H. S. Students with Laborers	.756	.891
Teachers with Engineers	.751	.856
Secretaries with Medical Men	.686	.855
Laborers with Business Men	.664	.837
Teachers with Business Men	.682	.815
Business Men with Medical Men	.629	.807
H.S. Students with Business Men	.644	.801
Housekeepers with Medical Men	.651	.797
Business Men with Engineers	.662	.751
Housekeepers with Engineers	.613	.721
AVERAGE INTER-GROUP CORRELATION	.751	.896
Total Number of respondents having had two or more years of chemistry with total having had only one year of chemistry	.766	.861

Table V

INTER-GROUP CORRELATIONS ON QUESTIONNAIRE NUMBER TWO

Groups	r	Corrected for attenuation
Teachers with Laborers	.817	1.000
Students with Teachers	.808	.979
Students with Laborers	.766	.922
Students with Pharmacists	.752	.904
Teachers with Pharmacists	.734	.879
Teachers with Engineers	.721	.866
Students with Nurses	.720	.852
Teachers with Nurses	.685	.850
Laborers with Pharmacists	.705	.838
Laborers with Nurses	.678	.837
Students with Engineers	.717	.821
Engineers with Laborers	.679	.811
Pharmacists with Nurses	.661	.780
Engineers with Pharmacists	.634	.717
Engineers with Nurses	.587	.688
AVERAGE INTER-GROUP CORRELATION	.710	.849

perfect agreement. Some erratic results are to be expected, but the uniformly high positive correlations give evidence of a consistent relative utility for all groups regardless of occupational status.

Questionnaires Numbers Three to Fifteen.

The results obtained with the remaining thirteen questionnaires will not be given in as great detail as those concerned with the first two. It will be recalled that the items of information contained in each of the questionnaires were taken from standard textbooks and that no attempt was made at classification of the items until after all of the items had been evaluated. The two questionnaires discussed above were answered predominantly by laymen. One apparent finding in the results given was pertinent to the continuance of the problem.

Evidence is seen in Tables IV and V of the consistently high agreement between the ratings assigned by high school seniors, who had studied chemistry in the junior year, with those of other occupational groups. The correlations of these student groups (when corrected for attenuation) range from .721 to 1.000 on questionnaire number one, and from .688 to 1.000 on questionnaire number two. These results indicate that responses from student groups alone might be used in securing evaluations on other items of chemical information. It was decided therefore to rely upon the responses of these groups to the remaining thirteen questionnaires. Obviously it would be much easier to secure a large number of responses from groups of students than an equal number of responses from individuals scattered at random.

It has been a consistent procedure in this study to secure responses from individuals who have studied chemistry at least one year prior to the time of responding to the questionnaires. This criterion was fulfilled by asking for responses from students who had studied chemistry the previous year and who were not at present taking additional work in the subject.

The analysis of the returns from the last group of questionnaires was made in the same manner as explained previously. There were approximately four widely scattered groups of respondents to each questionnaire. For the sake of brevity, only the reliabilities of the "index values" as derived from the total number of respondents on each questionnaire will be given in Table VI.

Table VI

THE RELIABILITY OF THE "INDEX VALUES" OF THE ITEMS IN QUESTIONNAIRES THREE TO FIFTEEN

No. of Questionnaire	No. of cases	r	Stepped-up
3	110	.886	.940
4	98	.864	.927
5	95	.846	.916
6	98	.872	.931
7	95	.869	.929
8	84	.839	.912
9	100	.879	.935
10	93	.906	.950
11	112	.835	.910
12	86	.888	.940
13	103	.875	.933
14	104	.853	.920
15	100	.915	.956

Inspection of the above table shows the reliabilities to be consistently high, and in keeping with results shown in Tables II and III.

Inter-group correlations were made between the "index values" assigned to the items by the various groups in order to determine the agreement in the relative order of rank. It should be borne in mind that these respondents are widely scattered as to location and have had varying degrees of training. Only the average inter-group correlations will be given in the following table. The range in each case is approximately .200.

The story told by the values in Table VII is practically the same as that evidenced by the first two questionnaires. When the obtained correlation coefficients were corrected for attenuation in order to take into consideration the degree of reliability of the "index values", the amount of agreement is very high.

Table VII

INTER-GROUP CORRELATIONS ON QUESTIONNAIRES THREE TO FIFTEEN

No. of Questionnaire	Average Inter-Group Correlation	
	r	Corrected for attenuation
3	.774	.946
4	.688	.849
5	.660	.812
6	.736	.935
7	.612	.912
8	.731	.870
9	.592	.762
10	.781	.899
11	.562	.692
12	.830	.998
13	.758	.918
14	.532	.637
15	.610	.677

A COMPARISON OF THE PRESENT STUDY WITH CERTAIN OTHER INVESTIGATIONS

Some studies of chemistry that have been reported in the literature are concerned with the analysis of textbooks, magazines, examination questions, and science activities. Certain of these investigations contain evaluations on topics for which it is possible to determine indexes of usefulness from the results of the present study. The procedure employed in arriving at an index of usefulness for a topic involved finding the means of the "index values" of all of the items of information concerned with the particular topic. The comparisons which follow may be considered sufficiently accurate to show general relationships.

Commercial Processes in High-School Chemistry.

Nathanson[1] obtained values for each of fifty commercial chemical processes indicative of the relative importance attached to these processes by teacher judgment and textbook emphasis respectively. These values were compared with the "indexes of usefulness" from the present study. It was found

1. J. M. Nathanson, "Commercial Processes in High School Chemistry", School Science and Mathematics, XXVI (June, 1926), pp. 628-635.

that when teachers estimate the importance of commercial processes their ratings agree more closely with the "indexes of usefulness" than does textbook emphasis.

Specific Objectives of High-School Chemistry.

The results of the present study were compared with a list of specific objectives in high-school chemistry as compiled by Persing.[1] The evidence indicates that there is very little agreement between frequency of mention of an objective and its usefulness as measured in the present study.

College Entrance Board Examinations.

Boorstein[2] analyzed the College Entrance Board Examinations in Elementary Chemistry for 1921-1928. The only data taken from his study were for the topics on which comparable ratings were available from the present study in the form of "mean index values." The evidence shows that the stress placed on a topic over a period of years by the College Entrance Board Examinations in Chemistry has a very low correlation (r = .160) with the "indexes of usefulness" that have been determined in the present study.

An Analysis of Activities Involving Science.

Stemple[3] made a determination of science needs of pupils in small high schools. It was possible to secure "mean index values" for certain of the topics given in his compilation. The coefficient of correlation was computed between these values and the percentage relationships of the various divisions of chemistry taken from the Stemple study. The resulting value, r = .769, seems to indicate considerable agreement between these two measures of functional values of chemical information, and to demonstrate the validity of the derived "index values."

Achievement.

Difficulty values were secured for a number of chemistry questions in the College Achievement Test, Part I, and for almost all of the questions in the Columbia Research Bureau Chemistry Test, Forms A and B. Pearson coefficients of correlation were then computed between these "difficulty values" and the "index values of usefulness" of corresponding items of information from the present study. In each case there was a distinct negative correlation between the difficulty of an item and its usefulness (the correlations equal respectively, -.478, -.500, -.450, and -.444). In other words, the best known items are not always considered the most useful although, as might be expected, there is a tendency in this direction.

CONCLUSIONS

1. The "index values" are distinctive measures of the relative utility of each of the 1550 items of chemical information listed in the complete study.
2. That the reports in this study are reliable (in contrast with the question of the size of the sample required to give reliable "index values") is indicated by the high correlations of .98 and .96 obtained between the results secured by two submissions of a list of items to two groups of respondents.
3. The reliabilities of the "index values" are consistently high, ranging from .910 to .956 with the total number of respondents on each questionnaire.
4. That the "index values" determined in this study are valid, that is, actually measure the usefulness of the items, is indicated in the comparison with the study by Stemple whereby it is shown that the "index values" are in rather close agreement with the extent to which the topics of information function in the activities of subjects (r = .769).
5. The high positive inter-group correlations indicate that the items of chemical information have a consistent relative utility for all individuals regardless of occupation, sex, and habitat.

1. Kimber M. Persing, "Present Specific Objectives in High-School Chemistry", Journal of Chemical Education VI (November, 1929) pp. 1959-78.
2. J. W. Boorstein, An Analysis of the College Entrance Board Examinations in Elementary Chemistry for 1921-1928, Unpublished Master's Thesis, New York University, 1930.
3. F. W. Stemple, Science Needs of Pupils in Small High School Based on an Activity Analysis, Unpublished Doctor's Dissertation, Cornell University, 1929.

6. There is practically no agreement between the "indexes of usefulness" and textbook consensus, teacher consensus, frequency of mention of objectives, stress of topics in examinations, and the science topics discussed in magazines.
7. The best known items are not considered the most useful, although there is a tendency in this direction.

IMPLICATIONS

This investigation has shown that the items of chemical information have approximately the same relative importance for all individuals. The beginning chemistry course can then be adapted in a practical way to the needs of all pupils by building the chemistry curriculum around the evaluated items.

The information that ranks highest may be taught to all. Advanced assignments on any unit of work may have quantitative and qualitative differentiation in accord with the ability and future interests of the students.

CLASSIFICATION OF THE ITEMS

It has been mentioned that the items were taken from four textbooks commonly used in high-school chemistry. Difficulties were sometimes encountered in attempting to make brief statements that are true and comprehensive. The principle followed in these situations was to formulate the information into statements that would have general acceptance in a course in elementary chemistry.

It is practically impossible to classify the items according to any scheme so that each item will occur but once in the total classification and at the same time appear under every heading to which it is pertinent.

It was finally decided to use the Periodic classification of the elements according to their atomic numbers as the basis for the classification of the items. The attempt was made to place each statement under the heading of the element with which it is usually associated. Fortunately a clear-cut and well-defined classification is not necessary since this is not intended for purposes of inter-class comparison or teaching units. In fact, a prime objective of this study is to ascertain the degree of usefulness of items of information within a group of subject matter rather than to compare types of information. It should be recognized that there is both important and unimportant information within almost any classification unit.

The items have been numbered serially, starting with the first one in Group 0 of Periodic Table and ending with the last item in the General Group (an added category to provide for laws, principles, general facts, etc.).

The "index values" of the total number of items have been grouped into a frequency distribution as shown in Table VIII. There is a distinct tendency for the values to be massed at the low end of the scale and spread out gradually at the high end (positive skewness). The decile points have been determined and are shown in the same table. Reference may be made to this table in order to determine the decile rank of any item.

Table VIII

PERCENTILES IN THE FREQUENCY DISTRIBUTION OF THE "INDEX VALUES" OF THE TOTAL NUMBER OF ITEMS

Index Values	F	Cum. F	Percentiles	Index Values
15.50-15.99	1	1550	100	15.95
15.00-15.49	2	1549	90	8.42
14.50-14.99	1	1547	80	6.60
14.00-14.49	2	1546	75 (Q_3)	6.04
13.50-13.99	2	1544	70	5.50
13.00-13.49	4	1542	60	4.52
12.50-12.99	2	1538	50 (Md)	3.91
12.00-12.49	7	1536	40	3.26
11.50-11.99	8	1529	30	2.66
11.00-11.49	9	1521	25 (Q_1)	2.37
10.50-10.99	15	1512	20	2.09
10.00-10.49	13	1497	10	1.52
9.50- 9.99	25	1484	0	0.46
9.00- 9.49	34	1459		
8.50- 8.99	23	1425		
8.00- 8.49	31	1402		
7.50- 7.99	35	1371	Q = 1.83	
7.00- 7.49	53	1336		
6.50- 6.99	51	1283		
6.00- 6.49	74	1232		
5.50- 5.99	73	1158		
5.00- 5.49	70	1085		
4.50- 4.99	89	1015		
4.00- 4.49	130	926		
3.50- 3.99	112	796		
3.00- 3.49	131	684		
2.50- 2.99	129	553		
2.00- 2.49	139	424		
1.50- 1.99	134	285		
1.00- 1.49	92	151		
.50- .99	58	59		
.00- .49	1	1		

THE EVALUATED ITEMS OF INFORMATION

The total list of 1550 evaluated items of chemical information, classified according to the Periodic classification of the elements, is reproduced here. The reader will note that the classification does not lend itself directly to teaching purposes. If there were available a scheme of subject-matter classification that had the approval of all curriculum workers, the writer would have preferred to group the statements according to that basis. For the present, each worker must make a re-classification that is in accord with the plan of organization of subject matter that he uses if it is desired to evaluate the chemistry curriculum by a utilitarian standard or to organize teaching units that have the subject matter differentiated according to qualitative as well as quantitative differences.

A teaching procedure that would have rather general acceptance would be to present to all the students minimum assignments that contain the most utilitarian information on any unit of work. Supplementary assignments on these units would contain the less utilitarian information. The less utilitarian subject matter tends to be the most difficult and under the proposed system would be studied only by the better students. As much and as many other kinds of additional work as he desires may be used by the instructor to supplement the assignment.

GROUP 0

THE INERT GASES

Number of Item	Index Value	Items
1	9.87	Helium is used in dirigibles, due to its lightness and non-inflammability.
2	4.64	Helium is the most difficult of all gases to liquefy.
3	4.59	Inert gases found in the air are neon, krypton, niton, and helium.
4	2.15	Argon was discovered by Lord Rayleigh and Sir William Ramsey in 1895.
5	2.02	Argon is colorless, more easily liquefied and solidified than nitrogen, and is more soluble in water.
6	1.41	The molecule of argon contains but one atom.

Number of Item	Index Value	Items

GROUP I

A. THE ALKALI METALS

7	13.24	Salt is used in preserving meat and fish for future use as food.
8	12.28	Salt is consumed in ice-cream making, and other refrigeration.
9	11.49	Sodium bicarbonate, or baking soda, is used in baking as a substitute for yeast.
10	11.18	Washing soda is used in the household for cleaning.
11	10.91	Salt is indispensable as food for animals, being used to furnish the chlorine for the hydrochloric acid in the gastric juice.
12	10.74	Salt may be extracted from salt water by evaporation or freezing.
13	9.67	Hydrogen was used extensively for filling balloons and airships.
14	9.67	When salt is added to water the freezing point is lowered.
15	9.60	Sodium bicarbonate is used as a medicine to neutralize excess acidity in the stomach.
16	9.58	Hydrogen is a very inflammable gas.
17	9.06	The commercial name for sodium hydroxide is caustic soda or lye.
18	7.94	Baking powders are composed of sodium bicarbonate and another substance such as cream of tartar.
19	7.83	Hydrogen is the lightest gas known.
20	7.18	Three kinds of baking powder are: "cream of tartar" powders, "phosphate" powders, and "alum" powders.
21	7.03	Washing soda and baking soda are important carbonates of sodium.
22	6.97	Sodium hydroxide is also known as "caustic soda" and lye.
23	6.94	Sodium chloride is the most abundant sodium or chlorine compound found in nature.
24	6.83	Sodium peroxide is used as an oxidizing and bleaching agent.
25	6.64	Sodium carbonate and sodium bicarbonate are important carbonates of sodium.
26	6.57	Ice that forms on the surface of salt water is free from salt.
27	6.40	Salt occurs as rock salt, in salt springs and wells, and in the water from the sea and lakes.
28	6.29	Potassium chlorate is used in fireworks, explosives, matches, and medicines.

Number of Item	Index Value	Items
		GROUP I - A. THE ALKALI METALS (continued)
29	6.27	Sodium and potassium hydroxides react with animal and vegetable fats and oils to form soaps.
30	6.25	Some salt is obtained from salt wells in New York State.
31	6.17	It is the impurities in salt that absorb moisture and cause it to become moist when exposed to the air.
32	6.02	Both sodium and potassium react violently with water to liberate hydrogen.
33	5.76	Sodium and potassium hydroxides have a corrosive action on such things as cotton, glass, and silk.
34	5.70	Washing soda loses its water of crystallization on standing.
35	5.66	Sodium and potassium hydroxides are bases.
36	5.57	Sodium carbonate is also known as washing soda, soda, sal soda, and soda ash.
37	5.47	The sodium flame is bright yellow.
38	5.20	The "free running salt" contains one per cent of magnesium carbonate which makes the salt crystals slide more easily.
39	5.10	Sodium nitrate is often called "Chile saltpeter."
40	5.01	Sodium should be kept under oil or in air-tight containers.
41	4.99	The free H ion gives acids their sour taste and turns blue litmus red.
42	4.77	Sodium is used in such compounds as drugs and dyes.
43	4.76	Water dissolves about one-third of its weight of salt, and the quantity is almost the same at all temperatures.
44	4.54	The commercial name for potassium nitrate is saltpeter.
45	4.49	Baking powder is a mixture of sodium hydrogen carbonate with a feebly acid substance.
46	4.41	Potassium and sodium nitrates occur in limited quantities in the soil.
47	4.38	The free H ion is present in all acids.
48	4.36	Potassium imparts a violet color to the flame.
49	4.33	Sodium bromide and sodium iodide are used in medicine and photography.
50	4.18	Sodium and potassium hydroxides are very strong bases.
51	4.18	Sodium bromide is used as a medicine, especially on diseases of the nervous system.
52	4.12	The term "potash" is applied commercially to impure, inexpensive grades of potassium chloride or sulphate.
53	4.01	Potassium carbonate is used in the making of soap and glass.
54	3.99	Potassium is more active chemically than sodium.
55	3.98	The chief market for sodium sulphate is in the glass industry.
56	3.92	A water solution of a neutral salt, such as sodium chloride, does not change the color of litmus.
57	3.78	Large deposits of potassium compounds are found in Germany and France.
58	3.74	Hydrogen is prepared in the laboratory by the action of zinc on sulphuric and hydrochloric acids.
59	3.61	Sodium joins with water to form sodium hydroxide and liberate heat and hydrogen.
60	3.60	Potassium nitrate is used to preserve meat.
61	3.46	Two volumes of hydrogen and one volume of oxygen combine with explosive violence, when an electric spark is introduced into the mixture, to form two volumes of water vapor.
62	3.44	Sodium possesses all the properties of metals, is light enough to float on water, and is soft and malleable
63	3.41	Sodium nitrite is much used in the manufacture of dyestuffs.
64	3.32	Hydrogen combines directly with nitrogen in the presence of a catalytic agent to form ammonia.
65	3.28	When sodium bicarbonate is heated water and carbon dioxide are driven off and sodium carbonate remains.
66	3.23	Sodium thiosulphate is the "hypo" of the photographer.
67	3.17	Sodium and potassium hydroxides are white, deliquescent solids.
68	3.17	Hydrogen is used in the oxyhydrogen blowpipe because of the high temperature of the hydrogen flame.
69	3.16	Elements, such as potassium, sodium, and lithium, may be identified by means of the spectroscope.
70	3.07	Lithium, sodium, and potassium belong to the family of alkali metals.

Number of Item	Index Value	Items
		GROUP I - A. THE ALKALI METALS (continued)
71	3.07	Potassium hydroxide is known as caustic potash.
72	3.02	Hydrogen is prepared commercially by the electrolysis of water, using a catalytic agent such as sulphuric acid.
73	2.98	Hydrogen cyanide smells like bitter almonds and is very poisonous.
74	2.90	The free H ion in solution neutralizes bases.
75	2.84	The Solvay process is used to prepare sodium carbonate.
76	2.80	Hydrogen is prepared commercially by passing steam over iron at high temperatures.
77	2.77	Hydrogen readily reduces oxides into metals and water.
78	2.73	Sodium carbonate is a white powder which has a bitter nauseous taste, and is poisonous.
79	2.73	The hydrogen atom has only one electron outside the nucleus.
80	2.61	Sodium does not occur native, but its compounds place it eighth among the elements in order of abundance.
81	2.60	Some elements, sodium for example, are very active because they have one or more free electrons.
82	2.55	Sodium hydroxide is obtained by the electrolysis of a water solution of sodium chloride.
83	2.50	Potassium occurs abundantly in combination in such minerals as feldspar and mica.
84	2.47	A solution of sodium cyanide dissolves gold.
85	2.47	Potassium carbonate can be separated from wood ashes by dissolving it in water.
86	2.32	Cavendish discovered in 1791 that hydrogen burns in air to form water.
87	2.29	"Glauber's salt" is the druggist's name for sodium sulphate with ten molecules of water of crystallization.
88	2.27	When heated above its melting point potassium chlorate gives off oxygen and passes into potassium chloride.
89	2.23	Sodium is used as a catalyzer in the manufacture of rubber.
90	2.20	Sodium hydroxide is made in the lye process by a reaction between sodium carbonate and calcium hydroxide.
91	2.18	Sodium sulphate is made by the action of sulphuric acid on sodium chloride.
92	2.16	Sodium and potassium are prepared by the electrolysis of their hydroxides.
93	1.90	Sodium peroxide is prepared by heating sodium in air free from carbon dioxide.
94	1.80	One liter of hydrogen weighs 0.09 of a gram.
95	1.78	Potassium chlorate is made by the electrolysis of a solution of potassium chloride.
96	1.77	Crude sodium nitrate is known as Caliche.
97	1.69	Hydrogen is used extensively in the preparation of lard substitutes.
98	1.58	Davy was the first to obtain sodium by electrolyzing the fused hydroxide.
99	1.55	Sodium thiosulphate and sodium sulphate are largely used as an antichlor after bleaching.
100	0.78	A liter of water at 20 degrees Centigrade dissolves 18.2 cc. of hydrogen.
		GROUP I
		B. THE COPPER FAMILY
101	14.15	Copper is used for wires and cables to transmit electric currents.
102	13.31	Copper is used in such articles as water heaters, kettles, and stills.
103	10.77	Copper is reddish in color, very malleable and ductile, and is a good conductor of electricity.
104	7.64	Silver is a white metal, capable of receiving and retaining a high polish.
105	7.60	Silver is the best conductor of heat and electricity.
106	7.57	Gold is soft, heavy, malleable, and very ductile.
107	7.53	Alloys of gold are used for jewelry, and in dentistry.
108	7.32	Silver is alloyed with other metals to make it hard enough to stand the wear and tear of constant use.
109	7.04	United States coins contain 90% of silver.
110	7.01	Copper sulphate is used in batteries, in electroplating, and as a mordant.

Number of Item	Index Value	Items
		GROUP I - B. THE COPPER FAMILY (continued)
111	6.99	Silver is the most common of the precious metals.
112	6.92	Mirrors are made by depositing a layer of silver on polished glass.
113	6.64	Copper is used in making electrotype plates for printing.
114	6.51	Gold is found in Africa, the United States, and Australia.
115	6.48	Silver plating is usually done by electrolysis.
116	6.44	Copper is used as a constituent of alloys, such as bronze and brass.
117	6.37	Pure gold is 24 carats fine, that is, it contains 24 parts by weight of gold, and no alloys.
118	6.28	Negatives are used in photography to produce positives called prints.
119	6.28	Gold is separated from sand and gravel by washing with water.
120	6.27	Tarnished silver may be cleaned by boiling in an aluminum dish containing a little baking soda.
121	6.26	Silver bromide is very important in photography because it is very sensitive to light.
122	6.24	Gold coins of the United States contain 90% gold and 10% copper.
123	6.17	Blue vitriol is the commercial name for copper sulphate.
124	6.14	Copper is used as a protective coating on iron.
125	5.86	Tarnished silver owes its color to a thin coating of silver sulphide.
126	5.72	Metallic silver produces the dark places on the negative which has been exposed.
127	5.66	Native silver is extensively found in Arizona, Mexico, and South America.
128	5.61	Carbon dioxide, in the presence of moisture, attacks copper to give it a greenish color.
129	5.58	Silver nitrate may be used to mark linens sent to the laundry.
130	5.30	Sterling silver contains 92.5% of silver.
131	5.19	Gold is extracted from poor ores by electrolysis.
132	5.16	In photography, a process of toning is used to produce prints of various colors.
133	5.13	Copper occurs native in northern Michigan, while its ores are most abundant in Arizona, Montana, Utah, and Michigan.
		GROUP I - B. THE COPPER FAMILY (continued)
134	4.93	In photography, the purpose of the fixing bath is to remove from the plate all unreduced silver bromide.
135	4.90	Silver chloride or silver bromide is used on photographic paper.
136	4.83	Copper sulphate is made for use as a fungicide, as Bordeaux mixture, with milk of lime.
137	4.56	Silver combines readily with sulphur or compounds containing sulphur.
138	4.47	When copper sulphate is heated it loses its water of crystallization and becomes a white powder.
139	4.30	Lunar caustic has a corrosive action on flesh.
140	4.25	Statuary bronze contains copper, tin, and a little zinc and lead.
141	4.24	Gold can be dissolved by aqua regia.
142	4.01	In silver plating, a sheet of silver is used as the anode and the object to be plated as the cathode, and a rather weak current is employed.
143	3.85	Gold and silver can be separated from their ores by electrolysis.
144	3.46	Restrainers and accelerators are used in photography to slow down and speed up the process of development.
145	3.39	Copper sulphate is prepared by a reaction between copper and sulphuric acid.
146	3.38	Much of the silver now used is obtained from sulphide ores, usually associated with lead, copper, arsenic, and gold.
147	3.30	Copper is readily attacked by nitric acid, but is less active with hydrochloric and sulphuric acids.
148	3.21	The refining of copper depends upon the ore used, but in the final stages it is usually refined by electrolysis.
149	3.13	Silver nitrate (lunar caustic) is a white solid prepared by dissolving silver in nitric acid and evaporating the solution.
150	3.10	Copper is separated from its ores by burning out the sulphur and reducing the oxide with carbon.
151	3.09	Many copper ores contain sulphides, oxides, carbonates, and silicates.
152	3.01	A developer is an alkaline solution of a weak reducing agent, of such

Number of Item	Index Value	Items
		GROUP I - B. THE COPPER FAMILY (concluded)
152	3.01	(continued) a strength that it affects the silver bromide only in those spots where the reduction has already been started by the action of the light during the exposure.
153	2.99	A colloidal suspension of gold imparts to glass a ruby red color.
154	2.94	Cupric oxide is used to color glass bluish green.
155	2.89	Copper forms both cupric and cuprous ions.
156	2.78	Cupric oxide may be prepared by heating copper in air.
157	2.55	Black, green, or blue tones are produced in photographic processes by immersing the print in solutions of gold or platinum compounds.
158	2.18	Sepia prints may be produced by converting the silver image to silver sulphide.
159	2.04	Copper is the only element that occurs free in large deposits.
160	1.97	$AgNO_3 + KCl = AgCl + KNO_3$.
161	1.84	$3\ Ag + 4\ HNO_3 = 2\ H_2O + NO + 3\ AgNO_3$.
162	1.78	Cuprous oxide occurs in nature.
163	1.75	Silver is obtained from lead ores by the Parke's process.
164	1.63	Gold is separated from the silver in the Parke's process by treating the alloy with hot concentrated sulphuric or nitric acid.
165	1.54	A delicate test for a cupric salt is the production of an intense blue with an excess of ammonia.
166	1.50	$Ag_2SO_4 + Cu = CuSO_4 + 2\ Ag$
167	1.26	Silver nitrate is known as "lunar caustic."
		GROUP II
		A. THE CALCIUM FAMILY
168	9.91	"Household ammonia", washing soda, and borax, are used in homes to soften water.
169	9.90	Temporary hard water may be softened by boiling.
170	9.55	Foods rich in calcium are, milk, peas, beans, and cheese.
171	8.87	Limestone is used as building stone, as stone for concrete mixtures, and roads.
172	8.42	The bones and teeth are largely composed of calcium compounds.
173	8.06	Radium was first isolated by Madame Curie.
174	7.78	Calcium carbonate occurs in such forms as marble, limestone, and chalk.
175	7.09	Plaster of Paris is used in making molds and casts.
176	6.65	Water containing dissolved bicarbonates, as those of calcium and magnesium, is known as temporary hard water.
177	6.52	The "plaster" used for walls of houses is a mixture of slaked lime and plaster of Paris.
178	6.10	Compounds of calcium are used with sulphuric acid to generate carbon dioxide for the production of carbonated drinks.
179	5.67	The rays emitted from radium render certain materials luminous, and kill bacteria.
180	5.55	The solution of the limestone accounts for the "caves" in limestone regions.
181	5.50	Water may be softened by treating it with slaked lime.
182	5.36	Pigments may be added to water paints to give colors.
183	5.08	Slaked lime is put on the soil to neutralize the soil acids.
184	5.07	Slaked lime is used in the manufacture of bleaching powder, in glass making, and for whitewash.
185	5.04	Strontium nitrate is used in fireworks, especially in making red fire.
186	4.95	Whitewash or calcimine is a suspension of slaked lime with whiting in water, protected by flour, paste, or glue as a protective colloid.
187	4.86	Permanent hard water generally contains sulphates of calcium and magnesium.
188	4.80	Calcium phosphate is used as a plant fertilizer.
189	4.78	Soft porous surfaces, like plaster, must first be sized with glue.
190	4.47	The rays emitted from radium, radon, and other members of the series produce many chemical and physiological effects.
191	4.44	The combination of water with calcium oxide is known as slaking.
192	4.27	The peculiar characteristics possessed by radioactive bodies are due to emanations and radiations they produce.

Number of Item	Index Value	Items
		GROUP II - A. THE CALCIUM FAMILY (continued)
193	4.18	The crust formed on the bottom of a teakettle is chiefly calcium and iron carbonates.
194	4.15	Calcium hydroxide dissolved in water forms a solution called limewater.
195	4.13	Radium occurs chiefly as an impurity in ores of uranium.
196	3.98	Plaster of Paris and hydraulic cement absorb water and then proceed to form crystals.
197	3.89	A gram of radium evolves each hour 118 calories of heat.
198	3.87	The various water-softening processes depend upon the change of soluble into insoluble compounds.
199	3.85	Pearls, coral, and various shells are largely calcium carbonate.
200	3.79	The term "radium" is applied in popular language to radium bromide.
201	3.75	Calcium hydroxide is a common base.
202	3.60	Calcium carbonate is one of the most abundant compounds occurring in nature.
203	3.58	Radium compounds are sold wholly upon the basis of their radium content.
204	3.44	Water and calcium oxide react to form calcium hydroxide.
205	3.43	Barium carbonate is an excellent rat poison.
206	3.27	Artificially-made calcium carbonate is used as: a dentifrice, polishing powder, pigment, and putty.
207	3.26	Calcium carbide is used to generate acetylene gas, and in the manufacture of calcium cyanamide.
208	3.26	Calcium chloride is a white deliquescent solid used in brine, and upon roads to keep them moist and free from dust.
209	3.22	The final decomposition product of radium is lead.
210	3.21	Freshly mixed cement, mortar, and plaster contain gels.
211	3.11	Limewater mixed with copper sulphate forms what is known as Bordeaux Mixture.
212	3.05	The stalactites and stalagmites found in limestone caves are composed of calcium carbonate.
213	2.91	The gamma rays are identical in character with the X-rays discovered by Roentgen, but of a shorter wave length.

Number of Item	Index Value	Items
		GROUP II - A. THE CALCIUM FAMILY (continued)
214	2.84	Zinc and barium carbonates are used to make protective coatings for structural steel.
215	2.83	Calcium carbonate, made artificially, is known as precipitated chalk or whiting.
216	2.80	Bleaching powder is made by passing chlorine over freshly slaked lime.
217	2.73	Lime is composed of calcium oxide.
218	2.68	Bone ash is largely calcium phosphate.
219	2.65	Calcium carbide is made by heating a mixture of lime and coke.
220	2.64	When bleaching powder is treated with acid, hypochlorous acid is formed which yields nascent oxygen to oxidize the coloring matter.
221	2.61	Calcium cyanamide is used as a fertilizer, and in the manufacture of ammonia.
222	2.52	Calcium compounds give an orange color to the Bunsen flame.
223	2.49	Rotary and long flame lime kilns are used to convert limestone into calcium oxide or quicklime.
224	2.48	When calcium carbonate is heated carbon dioxide is driven off and calcium oxide remains.
225	2.48	Three recognized types of radium radiations are designated as alpha, beta, and gamma.
226	2.47	When exposed to the air calcium chloride and caustic potash become wet.
227	2.42	Lime is used in the manufacture of iron and other metals.
228	2.40	Barium sulphate is used in the manufacture of white paints.
229	2.39	Beta particles consist of minute particles of negative electricity (electrons).
230	2.38	Plaster of Paris is made by heating gypsum.
231	2.32	A mixture of plaster of Paris and water expands slightly as it hardens.
232	2.29	Barium nitrate is used in making green fire.
233	2.29	Calcium hydroxide is used with sand to produce mortar.
234	2.24	Calcium is a very active metal, but has few industrial applications.
235	2.22	Mortar hardens by reacting with carbon dioxide to produce calcium carbonate.
236	2.12	When calcium hydroxide is heated it loses its water and is converted into calcium oxide.

Number of Item	Index Value	Items
		GROUP II - A. THE CALCIUM FAMILY (continued)
237	2.11	Gypsum is a variety of calcium sulphate.
238	2.08	Calcium carbonate is soluble in water containing carbon dioxide.
239	2.07	Calcium reacts slowly with water to form the hydroxide and hydrogen.
240	2.03	Carbon dioxide reacts with limewater to produce a white precipitate of calcium carbonate.
241	2.00	Calcium oxide is used in the limelight burner.
242	1.99	When carbon dioxide escapes from a solution of calcium bicarbonate calcium carbonate is deposited.
243	1.98	Milk of lime is lime water containing some undissolved calcium hydroxide.
244	1.90	$CaCO_3 + H_2O + CO_2 = Ca(HCO_3)_2$.
245	1.76	Barium chloride is used as a test for sulphates.
246	1.73	When calcimine is used as an inside paint a preservative, like alum, should be added.
247	1.60	Pure calcium is a silver-white metal of brilliant luster, and is harder than lead but softer than zinc.
248	1.54	Calcium chloride is obtained as a by-product in the manufacture of sodium carbonate by the Solvay process.
249	1.48	Precipitated chalk is a form of calcium carbonate made by mixing solutions of a calcium salt and a soluble carbonate.
250	1.46	Strontium and barium resemble calcium closely, but are much rarer.
251	1.45	Calcium fluoride (fluorite or fluor spar) is used in the preparation of hydrofluoric acid and as a flux in working metals.
252	1.31	"Opal glass" is made by using fluor spar.
253	1.25	Barium peroxide is obtained by heating barium nitrate to redness.
254	1.24	Calcium sulphate is an abundant compound of calcium.
255	1.14	Much water is now softened by the permutit process.
256	1.13	Volatile compounds of strontium color a flame red, and compounds of barium color it green.
257	1.12	Barium sulphate is found in nature as the mineral barite or heavy spar.
258	0.90	Calcite is a pure crystalline form of calcium carbonate.
259	0.86	Calcium cyanamide is made by heating calcium carbide in an atmosphere of nitrogen.
260	0.73	Calcite crystals show double refraction.
261	0.73	Calcimine is made by mixing slaked lime and precipitated chalk with a dilute solution of glue.
262	0.61	Metallic calcium is prepared by the electrolysis of calcium chloride.
		GROUP II - A. THE CALCIUM FAMILY (concluded)
		GROUP II
		B. THE ZINC FAMILY
263	14.27	Mercury is used in thermometers and barometers.
264	10.55	Mercury is commonly known as quicksilver, and is a silvery white liquid metal.
265	9.25	Mercury dropped on a gold ring will whiten it by amalgamating with the gold.
266	9.12	Magnesium is used in flashlight preparations, in fireworks, and in many light alloys.
267	8.85	Epsom salts (magnesium sulphate) is a common laxative.
268	8.03	Zinc is used as the active plate in electric cells.
269	7.44	Amalgams of silver and other metals are used in filling teeth.
270	7.33	Magnesium burns readily with a brilliant white light.
271	7.10	Zinc oxide is used as a pigment for paints, and in the preparation of rubber for tires.
272	6.94	Vulcanized fibre may be stronger than leather, and is used for trunks, washers, and valves.
273	6.28	Galvanized iron is iron covered with a layer of zinc.
274	5.94	Brass is composed of copper and zinc.
275	5.06	Mercury is a good conductor of electricity.
276	5.06	The vapor of mercury is highly poisonous.
277	5.03	German silver contains copper, zinc, and nickel.
278	5.01	Corrosive sublimate and bichloride of mercury are violent poisons, and are used as germicides and antiseptics.
279	4.78	Magnesium citrate and sulphate are valuable on account of their medicinal properties.

Number of Item	Index Value	Items
		GROUP II - B. THE ZINC FAMILY (continued)
280	4.54	Granulated zinc is much used in the laboratory.
281	4.44	Magnesium is a silvery white metal resembling zinc and calcium in properties.
282	4.43	Cadmium yellow is used as a pigment and in the coloring of toilet soaps.
283	4.34	Amalgams are alloys containing mercury.
284	4.29	Mercury is used in electrical appliances and in the preparation of paints.
285	4.13	Asbestos is a silicate of calcium and magnesium.
286	3.96	Zinc white is very white and does not blacken, but peels and requires more coats to cover the surface.
287	3.79	Mercuric oxide is used in pharmacy, and as a constituent of paint which is applied to ships below the water line.
288	3.78	Zinc is bluish white in color and is marketed in bars called ingots or spelter.
289	3.71	Dilute acids attack magnesium readily with the evolution of hydrogen.
290	3.66	When zinc is heated in air or oxygen it burns with a bluish flame.
291	3.57	Zinc sulphate, known as "white vitriol", is used in dyeing and as an astringent.
292	3.47	Zinc white (zinc oxide) is used as a base in paints.
293	3.46	The density of mercury is greater than that of lead so that iron easily floats on it.
294	3.45	All soluble zinc salts are poisonous.
295	3.29	Epsom salts (magnesium sulphate) is found in some spring waters.
296	3.09	Zinc chloride is used in the production of vulcanized rubber.
297	2.99	Mercury forms both mercurous and mercuric salts.
298	2.95	Zinc chloride is obtained by the action of hydrochloric acid on zinc.
299	2.86	The paint pigment vermilion is mercuric sulphide.
300	2.70	Wood that has been soaked in a solution of zinc chloride resists decay.
301	2.66	The action of dilute acids on zinc is hastened by the presence of substances like carbon or copper

Number of Item	Index Value	Items
		GROUP II - B. THE ZINC FAMILY (continued)
301	2.66	(continued) which act like cathode plates of a voltaic cell.
302	2.62	Mercurous chloride is used in medicine under the name of calomel.
303	2.44	Magnesium is the only metallic constituent of chlorophyll.
304	2.34	Amalgams are not true compounds as they have a varying composition.
305	2.29	The main use of cadmium is in the production of fusible alloys.
306	2.22	Mercury combines readily with the halogens and with sulphur.
307	2.17	Magnesium is obtained by the electrolysis of the chloride.
308	2.17	Mercury can be obtained as a fine gray powder by shaking with a substance such as flour which prevents the particles from uniting to form a fluid.
309	2.10	Between 100 degrees and 150 degrees zinc is malleable and ductile and can be rolled into sheets.
310	2.08	Magnesium oxide is a poor conductor of heat and is the best of all refractories.
311	1.98	Zinc ores are converted to the oxide and then reduced with carbon.
312	1.92	"Blue ointment", made by rubbing mercury with fat, is used in medicine.
313	1.83	The chief ore of mercury is cinnabar from which it is obtained by roasting.
314	1.83	Talc, soapstone, and meerschaum, are silicates of magnesium.
315	1.79	Mercuric oxide is usually obtained as a brick-red substance by heating the nitrate.
316	1.74	The common names of mercuric chloride are corrosive sublimate and bichloride of mercury.
317	1.68	Granulated zinc is prepared by pouring the melted metal drop by drop into water.
318	1.62	Mixtures of magnesium carbonate with magnesium hydroxide are used in pharmaceutical preparations, and in face powders.
319	1.50	Some common ores of zinc are zinc blende, smithsonite, and zincite.
320	1.32	Zinc sulphate is produced commercially by the careful roasting of zinc sulphide at a low red heat.
321	1.29	Magnesium oxide is made by heating magnesium carbonate.
322	1.15	Aluminum melted with small percentages of magnesium yields a white alloy called magnalium.

Number of Item	Index Value	Items
		GROUP II - B. THE ZINC FAMILY (concluded)
323	1.06	Cadmium is darker in color and denser than zinc, and has a lower melting and boiling point.
324	1.05	Zinc sulphide is found in nature as zinc blende.
325	1.02	Zinc sulphide is used with barium sulphate to make the pigment "lithopone."
326	0.97	Magnesium occurs in such compounds as dolomite, carnallite and kainite.
327	0.92	Many amalgams (mercury alloys) are used as cements.
328	0.79	Magnesium carbonate occurs in nature as magnesite.
		GROUP III
		BORON, ALUMINUM, and Rare Elements
329	12.27	Aluminum is used extensively in cooking utensils because it is a good conductor of heat and is not attacked by common foods.
330	10.56	Boric acid is a weak acid, and is valuable as a safe household antiseptic.
331	10.23	Concrete is a mixture of sand, water, gravel, and cement.
332	9.48	Powdered aluminum is used as a paint, and in flash-light powders for photography.
333	9.08	Aluminum and its alloys are used extensively in airplane construction.
334	7.61	Aluminum is the lightest of the common metals, and has a silver-white appearance capable of a high polish.
335	6.97	Cement is made from calcium carbonate (limestone) and aluminum silicate (clay).
336	6.70	Aluminum cooking utensils should not be washed in strongly alkaline solutions like lye and soda.
337	6.69	Borax is used as an antiseptic, and in soldering and welding.
338	6.45	Reenforced concrete consists of concrete with iron rods imbedded in it.
339	6.25	Pure aluminum is practically unaltered in air, but reacts with most acids and hydroxides.
340	6.24	Concrete will set as well under water as in air.

Number of Item	Index Value	Items
		GROUP III - BORON, ALUMINUM, and Rare Elements (continued)
341	5.68	Aluminum joins with many metals to form alloys such as aluminum bronze, and magnalium.
342	5.26	Aluminum hydroxide is used in clarifying water by coagulation.
343	4.72	Aluminum is used as aluminum foil, and as an electrical conductor.
344	4.14	Ordinary chrome alum is used as a styptic to check the flow of blood.
345	4.01	Artificial gems, such as sapphires, rubies, and the Oriental amethyst, are made from aluminum oxide.
346	4.00	The important compounds of boron are boric acid and borax.
347	3.71	Aluminum hydroxide is used as a mordant in dyeing to cause the dye to adhere to cotton goods.
348	3.34	Aluminum is prepared by the electrolysis of aluminum oxide in a suitable solvent such as cryolite (a fluoride of sodium and aluminum).
349	3.20	Clay and rock consist chiefly of aluminum silicate.
350	3.16	The silicates of aluminum, such as kaolin and clay, are used in making pottery, bricks, and tile.
351	3.05	Useful aluminum minerals are corundum, bauxite, cryolite, emery.
352	2.85	Lakes are used in dyeing and as pigments.
353	2.53	Aluminum oxide occurs in such forms as emery, ruby, and the sapphire.
354	2.28	Borax is sodium tetraborate.
355	2.12	Aluminum is a powerful reducing agent and is used to obtain many metals in the free state.
356	2.10	The Thermit process for welding uses aluminum to reduce the oxide of the metal to be welded, with the liberation of intense heat.
357	2.00	Fused borax dissolves metallic oxides, cobalt giving a blue color and manganese a violet color.
358	1.99	Some laboratory utensils are made of aluminum oxide under the trade name "alundum."
359	1.70	The combination of the color and aluminum hydroxide is called a lake.
360	1.19	Aluminum salts of weak acids hydrolyze easily.
361	1.16	Alums contain a univalent and a trivalent metal, and are a kind of doublt salt.
362	0.91	Double salts contain two metals joined to one kind of acid radical, or one metal joined to two acid radicals.

Number of Item	Index Value	Items
		GROUP IV
		A. THE CARBON FAMILY
		1. Carbon
363	15.95	Gasoline, a product of petroleum, is the chief fuel for automobiles and other motors.
364	15.44	A complete diet must supply vitamins.
365	15.00	A diet which includes milk, vegetables, eggs, and fruit assures an adequate supply of vitamins.
366	14.59	The body needs a balanced diet of proteins, fats, carbohydrates, mineral matter, water, and vitamins.
367	13.46	Linen conducts heat readily and hence is cool and is used for summer clothing.
368	12.41	Grease stains should be removed from clothing by dissolving them in a suitable solvent.
369	11.96	Various agents for removing stains are: oxalic acid for ink stains; Javelle water for blood; carbon tetrachloride for fats and oils.
370	11.64	Chloroform is an important solvent and an important anaesthetic.
371	11.52	Petroleum is converted by destructive distillation into various products, as, gasoline, benzine, kerosene, gas oils, lubricating oils, vaseline, paraffin, and coke.
372	11.37	Linen is obtained from the stalks of flax.
373	11.07	Vitamins A, B, C, D, and E have been identified.
374	11.02	When cleaning such things as gloves it is safer to use a non-combustible material like carbon tetrachloride.
375	10.86	Any fuel must be heated to its kindling temperature before it will burn.
376	10.82	Carbon monoxide is colorless, is inflammable, and highly poisonous.
377	10.71	The protein of the food is used by the body for the construction and repair of tissues.
378	10.64	Citric acid is found in the juices of lemons, oranges, limes, etc.
379	10.57	Coal contains large quantities of free carbon.
380	10.55	Carbon is an important constituent of animal and plant tissues, and of all foods that we consume.
381	10.50	Coke and charcoal may be used as fuels.
382	10.37	Deficiency of vitamin B results in a type of paralysis known as beriberi.
383	10.27	Coal is a form of fossilized wood --wood which has been buried underground for centuries and lost much of its hydrogen and oxygen.
384	10.23	Methyl alcohol is a poison and may cause blindness or death if taken inwardly.
385	10.04	Some stains must be converted into a soluble compound and then washed out with water.
386	10.01	Pure carbon is found in the free state in the form of diamond and graphite.
387	9.95	Carbon dioxide is used extensively in fire extinguishers because the gas excludes oxygen from the flame.
388	9.90	Deficiency of vitamin C results in scurvy.
389	9.89	Plants extract an enormous amount of carbon dioxide from the air to make starch. An equal amount of oxygen is returned.
390	9.87	Vitamin E plays a role in reproduction.
391	9.82	Acetic acid is produced when hard cider changes to vinegar.
392	9.63	Most of our supply of gasoline is derived from the destructive distillation of petroleum.
393	9.61	Oxygen must be supplied to cause combustion of gaseous and liquid fuels.
394	9.48	Hides are tanned to cure them and prevent decay.
395	9.48	Silk is a gelatinous secretion of the silkworm.
396	9.45	Lysol is an important antiseptic.
397	9.45	Solid carbon dioxide or dry ice is used in refrigeration.
398	9.45	Ether is a volatile inflammable liquid used as a solvent and as an anaesthetic.
399	9.32	Soap acts as a protective colloid in preventing particles of dirt from adhering to each other.
400	9.06	Acetylene is used as a fuel, as an illuminating gas, and in the oxy-acetylene blowpipe.
401	9.02	Liquefied carbon dioxide is used in all forms of effervescent beverages.
402	9.02	The oxidation of the carbon in the tissues of the body produces carbon dioxide which is then exhaled from the lungs.

GROUP IV - A. THE CARBON FAMILY
1. Carbon (continued)

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
403	9.00	Manila is used for rope.
404	8.99	Maltose (malt sugar) is found in malt, which is the sprouted grain of barley.
405	8.95	Vitamin D is essential to the nutrition of the bone.
406	8.94	Kid is goat or sheep skin.
407	8.90	Bituminous coal is black and soft and contains about 75% of free carbon.
408	8.77	Carbon monoxide is usually formed in the incomplete combustion of coal in a stove.
409	8.73	Lactose (milk sugar) occurs in milk.
410	8.72	Coke is prepared by heating coal in the absence of air.
411	8.67	Fuel in the form of gas and oil is obtained from wells bored in the ground to the fuel-containing rock.
412	8.64	Cellulose is the chief ingredient of cotton, linen, hemp, and paper.
413	8.58	The carbohydrate starch is made in the leaves of plants.
414	8.52	Graphite is used in the manufacture of lead pencils, crucibles, as a lubricant, and in paints.
415	8.48	Glucose is used in making candies and table syrup.
416	8.39	Vulcanization of rubber renders it strong, elastic, insoluble, and resistant to wear and weather.
417	8.35	Proteins are compounds containing carbon, hydrogen, oxygen, nitrogen, and may contain sulphur and other elements.
418	8.33	Intoxicating beverages owe their properties to ethyl alcohol.
419	8.32	Saccharin is about 400 times as sweet as sugar.
420	8.29	Cellulose is the chief constituent of the cell walls of plants.
421	8.28	Wood alcohol is used as a solvent in making lacquers, varnishes, and aniline dyes.
422	8.25	Smoke is caused by incomplete combustion.
423	8.22	Methane is the chief constituent of natural gas.
424	8.20	Materials, such as starch, gum, and paraffin, are added to cloth to size it (give it stiffness).
425	8.12	Deficiency of vitamin A results in an infectious eye disease.
426	8.12	Cane sugar is obtained from the juices of the sugar cane and beets.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
427	8.06	Various oils may be used for illuminating purposes in such forms as the candle and lamps.
428	7.99	Carmel is made by heating sugar to 215 degrees C.
429	7.97	Wood alcohol burns with a flame of high heat value and is suitable for use in alcohol stoves.
430	7.95	Natural gas is used as a fuel and as an illuminant in such localities as it is found.
431	7.91	Coal is converted by destructive distillation into coal gas, ammonia, coal tar, and coke.
432	7.72	The finer grades of paper are made from cotton and linen rags, and the cheaper grades from wood.
433	7.70	Coke is used as a reducing agent in the blast furnace, and as a fuel.
434	7.63	Denaturated alcohol is ethyl alcohol to which a poisonous substance has been added.
435	7.59	Shellac is dissolved in alcohol to make a quick drying varnish.
436	7.50	Devices such as carburetors and gasoline torches are used to vaporize the liquid and so secure a hotter flame.
437	7.48	Kerosene is not so volatile as gasoline and hence cannot be ignited so easily.
438	7.48	Protective colloids in ice cream prevent crystallization of the water into ice.
439	7.46	Some of the commoner vegetable alkaloids are: nicotine, present in tobacco leaves; atropine, used for dilating the pupil of the eye; cocaine, sometimes used as a local anaesthetic; quinine, used in the treatment of malaria; strychnine, sometimes used in small doses as a tonic; and morphine, the chief alkaloid of opium.
440	7.36	Lacquers have rapidly displaced varnishes and paints on automobiles and furniture.
441	7.33	The cell walls of plants are composed of a carbohydrate called cellulose.
442	7.33	Saccharin is used as a sweetening agent in mouthwashes and toothpastes.
443	7.31	Bakelite is used to make pipe stems, billiard balls, radio panels, etc.
444	7.31	Dyeing involves the adsorbing of dyes by the fibers.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
445	7.30	Bombs and hand grenades contain high explosives which are not so insensitive as those used in shells since they are not fired from a gun.
446	7.26	Coke is used as a fuel and as a reducing agent in the preparation of iron from iron ore.
447	7.26	The outer blue mantle of the candle flame is the region of complete combustion.
448	7.25	Lactic acid is formed when milk sours.
449	7.22	Tannic acids are employed in the making of leather, as mordants in dyeing, and in the making of inks.
450	7.20	Carbon is found in three allotropic forms, namely, diamond, graphite, and amorphous carbon.
451	7.20	Methane forms a very explosive mixture with oxygen.
452	7.18	Knots in wood must be treated with shellac before painting.
453	7.17	Natural gas is obtained by sinking holes deep into the ground.
454	7.15	Paper consists mainly of cellulose.
455	7.14	Rubber is obtained from the milky sap, or latex, of trees.
456	7.12	Gasoline is not so volatile in winter and requires some heat to break it up into the small particles for the explosive mixture.
457	7.10	The essential materials from which soap is made are, a mixture of fats, and a solution of sodium hydroxide.
458	7.04	Wood is hygroscopic, is a poor conductor, and is a protein.
459	6.98	Carbon tetrachloride is a good grease solvent and is used in certain types of fire extinguishers.
460	6.97	Wool is amphoteric and hence is easily dyed.
461	6.97	Glycerine is used extensively in cosmetic and medicinal preparations.
462	6.96	Turpentine is largely used in making paint and varnish.
463	6.94	An enzyme is a product of a living cell and acts as a catalyst in certain chemical changes.
464	6.91	Coagulation or gelation of colloids is shown by the curdling of milk or the clotting of blood.
465	6.88	The inner part of a flame contains combustible gases.
466	6.83	Dynamite is nitroglycerine dissolved in some porous substance such as wood pulp.
467	6.82	Ethylene glycol is a colorless syrupy liquid which is used in automobile radiators in the winter time because it does not freeze readily.
468	6.82	Carbon unites with other elements to form a large number of compounds.
469	6.75	Suède is made from young calves' hides by finishing them on the inside.
470	6.75	Oil is transported by pumping through pipe lines.
471	6.68	Carbon monoxide unites with the haemoglobin of the blood forming a stable compound and soon causing death.
472	6.66	An explosion is due to a sudden chemical reaction in which the volume of the gases formed is much larger than that of the reacting substances.
473	6.65	Impure methyl alcohol is sold as wood alcohol.
474	6.62	Tinctures are solutions in which alcohol is the solvent.
475	6.56	Turpentine is a thin colorless liquid, lighter than water, and insoluble in it.
476	6.55	Carbon dioxide is a colorless gas, heavier than air, and non-poisonous.
477	6.52	High explosives are fired by detonation; low explosives by ignition.
478	6.51	When combustible material is finely divided it burns more rapidly and may become explosive.
479	6.50	Nitroglycerine detonates when heated to 257° C., and when subjected to a sudden shock.
480	6.45	Carbon dioxide is one product formed whenever carbon or any compound containing carbon is burned.
481	6.45	When nitroglycerine explodes it decomposes into gaseous products.
482	6.45	Water solutions of formaldehyde are used for the preservation of anatomical specimens.
483	6.44	Patent leather is made by treating certain kinds of leather with varnish.
484	6.36	Proteins are first broken down into amino acids in the digestive tract.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
485	6.35	Floating soaps owe their lightness to bubbles of air.
486	6.33	When gases are compressed the explosive mixture is more sensitive and more efficient.
487	6.29	Rosin is a brittle, brown, transparent solid.
488	6.25	Gases are more explosive than liquids because they are already in the molecular state.
489	6.24	Gelation (coagulation) may be brought about by mechanical agitation as in churning; by acids as in the curdling of milk; and by alkalies as in the softening of peas with baking soda.
490	6.22	The common thinners used for paint are oil of turpentine, petroleum oils, coal tar, naphtha, and denatured alcohol.
491	6.20	Foamite is particularly effective in putting out oil fires. It forms a tough foam of carbon dioxide which covers the surface of the burning substance and completely excludes the air.
492	6.17	Linseed and corn oils, and, to some extent, turpentine, are called drying oils.
493.	6.12	Some common sugars are levulose or fruit sugar, dextrose or grape sugar, saccharose or cane sugar.
494	6.11	A soap is a metallic salt of a fatty acid.
495	6.10	Black gunpowder is used chiefly in fuses, in blasting, and in firearms.
496	6.10	Oxalic acid is a mild reducing agent and is used in the removal of fresh iron and ink spots from white cloth.
497	6.09	A carbohydrate is a compound of carbon, hydrogen, and oxygen, in which there are two atoms of hydrogen for each atom of oxygen.
498	6.05	The yellow or illuminating flame (gas, candle, etc.) is caused by heating the carbon particles to incandescence.
499	6.02	Glossy paper is obtained by the use of casein--the protein present in milk.
500	5.99	Lampblack is used in printers' ink and in paints.
501	5.99	Glycerine is a thick liquid having a sweet taste.
502	5.97	A hydrocarbon is a compound composed of hydrogen and carbon.
503	5.95	Oleomargarine differs from butter in that it is made from the fat of hogs, cattle, and such vegetable oils as coconut and cottonseed.
504	5.92	Jute is made into coarse bags, rugs, and twine.
505	5.91	The bite of an insect causes the albumin to absorb water thus producing a swelling.
506	5.87	Natural silk is a mixture of compounds of nitrogen, while rayon (artificial silk) is a form of cellulose.
507	5.78	The names Ethyl Alcohol, Alcohol, and Grain Alcohol, are used to signify the alcohol prepared by the fermentation of certain sugars.
508	5.76	Starch is prepared in various varieties as, thick-boiling starch, soluble starch, and thin boiling starch.
509	5.75	Glue, starch, asphalt, soap, rubber, and meat are examples of colloids.
510	5.72	Black gunpowder is a mixture of niter with charcoal and sulphur.
511	5.70	Creosote acts as a preservative for wood.
512	5.70	Destructive distillation is the process of decomposing complex organic substances by heat in closed vessels and condensing the vapor of the liquid products.
513	5.68	Enamels are mixtures of oil varnishes with pigments or paints with the addition of resin or gum.
514	5.67	A flame is prevented from igniting an explosive mixture of gases by inclosing it in a wire gauze.
515	5.66	Putty is a mixture of linseed oil and whiting.
516	5.64	Sugar solution is filtered through boneblack to remove the coloring matter.
517	5.62	Methyl alcohol is obtained by the destructive distillation of wood.
518	5.61	Oil was first obtained in large quantities from a well drilled near Oil Creek, Pennsylvania.
519	5.61	Cheese is made from the casein of milk.
520	5.61	Tartaric acid occurs in many fruits in the free state or in the form of one of its salts.
521	5.52	The products of destructive distillation are separated by fractional distillation.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
522	5.50	Toluene is used in making the explosive T.N.T.
523	5.46	Potassium acid tartrate is cream of tartar.
524	5.45	Alcohol is separated from the fermented substance by distillation.
525	5.40	Methane is called marsh gas and fire damp.
526	5.40	A percussion fuse will start an explosion only when the shell hits some object.
527	5.40	Carbon dioxide in solution forms carbonic acid.
528	5.38	Benzene is a good solvent for fats and resins.
529	5.37	Detonation is brought about by the explosion of a small amount of some other explosive.
530	5.28	Scouring soaps contain finely powdered sand of volcanic ash.
531	5.21	Ordinary filter paper will hold back colloids.
532	5.21	Vinegar is often added to cane sugar in candy making to hasten the conversion into dextrose and levulose.
533	5.20	Carbon dioxide is necessary in the leavening of bread.
534	5.19	The most important drying oils are linseed, poppy, and chinese wood oils.
535	5.15	The four varieties of coal are peat, lignite, bituminous, and anthracite.
536	5.09	The higher hydrocarbons, such as kerosene, may be converted by cracking into more useful lower hydrocarbons such as gasoline.
537	5.08	Coal gas is important in household use.
538	5.08	The tissues of the human body are colloids and involve many colloidal changes.
539	5.08	Nitrogen compounds are easy to decompose as the nitrogen does not combine readily to form compounds.
540	5.06	Pitch or asphalt is removed by gasoline or kerosene.
541	5.03	Commercially, the name glucose means corn syrup.
542	5.01	Sizing is usually a thin glue meant to make the surface nonporous.
543	4.99	Carborundum is the greatest abrasive known.
544	4.99	Hard rubber goods contain more sulphur than soft rubber.
545	4.99	Paint and varnish should not be washed with strong alkalies.
546	4.98	Vanillin is used in perfumery and as a flavoring agent.
547	4.91	Benzene is produced during the destructive distillation of soft coal.
548	4.88	Parchment paper is obtained by treating paper with sulphuric acid.
549	4.87	Crepe is made by shrinking silk in sulphuric acid.
550	4.85	A shrapnel shell contains only a low explosive, and is filled with bullets.
551	4.85	Yeast forms enzymes, one of which, called zymase, has the power of causing a number of sugars, for example, glucose, to change to alcohol and carbon dioxide.
552	4.81	Some oils are now used as fuels by spraying them into the furnace by compressed air.
553	4.80	Nitroglycerine is manufactured by injecting glycerine into a cooled mixture of nitric and sulphuric acids.
554	4.79	All sticky, tarry, plastic substances are in the colloidal condition, as, glue, gelatin, rubber, cheese.
555	4.74	Rubber becomes useful only on coagulation which is accomplished by the use of acids.
556	4.68	The combustion of a substance that passes into a vapor before burning produces a flame.
557	4.68	Methane is the chief constituent of natural gas.
558	4.66	Carbon dioxide is formed when baking powder comes into contact with water.
559	4.65	Acetylene is produced by a reaction between calcium carbide and water.
560	4.64	Milk and mayonnaise are examples of emulsions.
561	4.63	When the sap from a pine tree is distilled turpentine vaporizes and rosin remains in the retort.
562	4.62	Water gas is a valuable fuel.
563	4.62	Lampblack is prepared by burning oil or gas with an incomplete supply of air.
564	4.55	Lysol is a preparation containing the cresols.
565	4.53	Rosin is used in sizing paper, in preparing lubricants, in makin-

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
565	4.53	(continued) cheap soaps, as a constituent of varnish.
566	4.47	Denatured alcohol is tax free and is used industrially.
567	4.46	Nitric acid turns some proteins to a yellow color which becomes orange when ammonia is added to it.
568	4.46	Wood charcoal and boneblack are obtained by destructive distillation from wood and bones respectively.
569	4.43	A mixture of powdered limestone and asphalt is used in street paving.
570	4.42	Foaming is a characteristic of colloids, as in soap and foods.
571	4.41	Natural gas contains methane and other hydrocarbons.
572	4.39	Indigo, an important dye obtained from the indigo plant, may be regarded as derived from indole.
573	4.38	Petroleum consists of compounds of carbon and hydrogen.
574	4.38	Artificial silk and non-inflammable films are made from cellulose acetate.
575	4.36	Oxalic acid is used in printing, dyeing, and tanning.
576	4.32	Much cornstarch is hydrolyzed to dextrose.
577	4.32	Oil stains are very thin paints with specially ground colors thinned with turpentine.
578	4.29	Blotting paper and paper towels are not sized.
579	4.26	The gummy materials in natural sugars are removed by coagulation with milk of lime.
580	4.26	Linoleum consists of a sheet of canvas covered with hardened linseed oil and cork pressed on by rollers.
581	4.26	Paint or varnish may be removed with a mixture of one part of soda lye and three parts of quicklime.
582	4.25	Carbon dioxide composes only about 0.04% of the air.
583	4.22	A varnish is usually a true solution of a gum or a resin in a thinner.
584	4.18	Glycogen (animal starch) is found in large quantities in the liver.
585	4.18	Mercerized cotton is made by treating cellulose with a cold concentrated solution of sodium hydroxide.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
586	4.17	Starch is changed to dextrine when toasted and as such is a valuable food.
587	4.16	Examples of turpenes are: pinene, menthol, and camphor.
588	4.15	To increase the flow of oil the drilled well is often torpedoed.
589	4.12	Organic acids are characterized by the carboxyl group (COOH).
590	4.10	The tip of a flame is called an oxidizing flame, and the tip of the luminous cone is called the reducing flame.
591	4.10	Ethylene is used extensively as anaesthetic, for accelerating the ripening of fruits, and for coloring fruits such as oranges and lemons.
592	4.10	When boiled with acids cellulose is slowly converted into a sugar called glucose.
593	4.07	It is possible to produce gasoline by combining hydrogen with the carbon in low grade coal.
594	4.06	Smokeless powder is guncotton which has been treated with ether and alcohol.
595	3.93	Maple sugar consists of sucrose, its distinctive flavor being due to other substances present in the sap.
596	3.93	Black rubber contains lampblack.
597	3.92	Celluloid is marketed under such names as, imitation ivory, pyralin, and xylonite.
598	3.92	Lignite is brown coal.
599	3.90	The test for a carbonate is as follows: A carbonate plus dilute acid yields carbon dioxide which turns limewater milky.
600	3.90	Dextrose is converted by a ferment of the yeast plant into alcohol and carbon dioxide.
601	3.89	Asphalt, or mineral pitch, is composed of a mixture of hydrocarbons.
602	3.87	Carbon monoxide in combination with chlorine forms phosgene, a poisonous gas used in the World War.
603	3.85	Many smokeless powders are made from nitrocellulose.
604	3.84	An ester is the product, other than water, formed when an alcohol reacts with an acid, the alcohol taking the part of a base.
605	3.84	Peat is a brown mass of roots and leaves.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
606	3.82	Barley sugar is made from common sugar.
607	3.81	Crude petroleum is lighter than water and varies in color from clear brown to greenish black.
608	3.77	Many colloids have the power of taking up the liquid in which they are suspended, as in the swelling of gelatine.
609	3.76	Carbon is a powerful reducing agent.
610	3.76	Carbonates react with acids to liberate carbon dioxide.
611	3.74	Colloidal gold imparts to glass a ruby red color.
612	3.74	Linseed oil is obtained from completely refined flaxseed.
613	3.74	Alcohol from which the water has been removed is known as absolute alcohol.
614	3.73	Malic acid is present in unripe apples, cherries, and grapes.
615	3.71	Producer gas is used for illumination and as a fuel.
616	3.64	Carbon dioxide is prepared in the laboratory by the action of hydrochloric acid on calcium carbonate.
617	3.62	Boneblack is used in the decolorization of sugars and oils.
618	3.58	Much of the phenol of commerce is obtained from coal tar.
619	3.58	Animal and vegetable oils and fats are esters of glycerine and various organic acids.
620	3.54	The turpenes are used extensively as flavors, in perfumery, and in medicine.
621	3.53	Examples of colloids in cooking are: swelling of starches, and coagulation of meat on heating.
622	3.53	The Welsbach burner is used to get good illumination from natural gas.
623	3.52	Cordovan is horsehide.
624	3.52	Benzene is one of the many ring compounds.
625	3.51	Water gas is produced by the reduction of steam by heated carbon.
626	3.49	Common substitution products of methane are chloroform and carbon tetrachloride.
627	3.45	Plasticity corresponds to the gel stage, as shown by rubber, clays, and celluloid.
628	3.44	Lactose (milk sugar) is present in milk of all mammals.
629	3.36	Lactalbumin, always present in milk, is a protective colloid.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
630	3.35	Accelerators, such as zinc oxide, are added to hasten the vulcanization of rubber.
631	3.34	Rosin, left after distillation of turpentine, is the chief ingredient of cheap varnish.
632	3.33	Each of the products obtained from petroleum consists of a group of compounds boiling over a certain temperature range.
633	3.27	The swelling of such colloids as gelatine and wood is the colloid going into solution by taking up the necessary liquid.
634	3.25	Prest-O-Lite is acetylene dissolved in acetone.
635	3.23	Carbon is extremely inert at ordinary temperatures.
636	3.22	Dextrine is prepared by roasting starch.
637	3.22	In the manufacture of sugar the sugar solution is evaporated in a vacuum pan at a low temperature to prevent inversion of the sugar.
638	3.15	Methane burns according to the formula, $CH_4 + 2\ O_2 = CO_2 + 2\ H_2O$.
639	3.08	Butter fat consists principally of palmitin, stearin, and olein.
640	3.03	Gelatin, an example of a reversible colloid, coagulates at a low temperature, and peptizes when warmed.
641	3.02	Acetone is a solvent for resins, gums, and acetylene.
642	2.99	Structural formulas are used to represent the arrangement of the atoms in the molecules of carbon compounds.
643	2.98	Anthracite coal is hard, dense, and shiny. It contains about 90% free carbon.
644	2.95	Clothing is material in the colloidal condition.
645	2.91	Glycogen (animal starch) is found in the liver.
646	2.85	Butyric acid, found in rancid butter, is used in the preparation of some delicate perfumes.
647	2.85	Proteins are now considered combinations of amino acids.
648	2.84	Vegetable alkaloids are complex organic bases.
649	2.77	Carbon monoxide is a powerful reducing agent.
650	2.76	Aspirin is a derivative of salicylic acid.
651	2.76	Formic acid and formaldehyde are prepared by the oxidation of methyl alcohol.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
652	2.71	Picric acid is a powerful explosive.
653	2.69	Producer gas is made by combining coal and a regulated supply of oxygen.
654	2.68	Hydrocyanic acid is the dangerous poison commonly called "prussic acid."
655	2.65	Bakelite is prepared from phenol and formaldehyde.
656	2.65	Nitric acid acts on cellulose to form nitrocellulose.
657	2.65	Dextrines are used in adhesives and in the textile industries.
658	2.62	Saccharose is converted into dextrose and levulose by boiling with water.
659	2.62	Benzoic acid occurs in resins and gums.
660	2.62	Shingle stains are a mixture of benzene, creosote, oil, drier, and color.
661	2.59	Lacquers are made of cellulose nitrate, camphor or some similar material, some organic base, usually rosin, and a pigment.
662	2.58	Graphite is found in New York State, Ceylon, Australia, the Alps, and other places.
663	2.53	Cordite is a smokeless powder made from guncotton and nitroglycerine by the use of a solvent acetone.
664	2.49	Kapok is a cellulose fiber used for pillows.
665	2.47	Heat causes carbon tetrachloride to evaporate, forming a heavy gas that displaces the air in contact with the combustible material.
666	2.47	$2\ CuO + C = 2\ Cu + CO_2$.
667	2.44	Benzoic acid is used in the manufacture of dyes.
668	2.36	Celluloid is made by incorporating camphor with pyroxylin.
669	2.35	Skins of animals consist of colloids.
670	2.32	Water gas may be enriched by mixing it with oil vapor so that it can be used for illuminating purposes.
671	2.27	Carbon monoxide is prepared in the laboratory by heating oxalic acid with concentrated sulphuric acid and passing the product formed through a concentrated solution of sodium hydroxide to remove the carbon dioxide, and collecting the remainder by displacement of water.
672	2.25	Glycerine is a trihydroxy of propane.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
673	2.23	Cooking of meat, clotting of blood, staling of bread, are all examples of syneresis.
674	2.23	Drying oils are sometimes adulterated with fish, cotton, corn, and petroleum oils.
675	2.12	Sols may set to form gels as when gelatine sets when it is cooled.
676	1.99	Phenacetin is used to reduce fever and relieve pain.
677	1.98	Collodion is a solution of pyroxylin in a mixture of alcohol and ether.
678	1.95	Phosgene is very poisonous and is used in warfare.
679	1.92	$Fe_2O_3 + 3\ CO = 2\ Fe + 3\ CO_2$.
680	1.89	The calcium and magnesium salts of oleic, palmitic, and stearic acids are insoluble in water and are therefore precipitated when hard water containing soluble calcium and magnesium salts is added to soap.
681	1.87	$6\ CO_2 + 5\ H_2O = C_6H_{10}O_5 + 6\ O_2$.
682	1.85	The mantle of the Welsbach burner contains thorium and cerium which glow brightly when heated strongly.
683	1.83	$3\ C + SiO_2 = SiC + 2\ CO$.
684	1.79	Glycerine is hygroscopic and dissolves a great number of substances.
685	1.70	Cyanogen is a colorless gas which smells like bitter almonds and is intensely poisonous.
686	1.62	The diamond was obtained artificially by Moissan, the French chemist, as early as 1890.
687	1.61	Two esters of inorganic acids are ethyl nitrite, and nitroglycerine.
688	1.59	Common organic acids are palmitic, stearic, and oleic acids.
689	1.53	In the form of a gas or water solution, formaldehyde is a valuable germicide and disinfectant.
690	1.53	Formaldehyde is a gas at ordinary temperatures.
691	1.51	The general formula for the acetylene series is C_nH_{2n-2}.
692	1.51	Gas mantles are dipped into an alcoholic solution of collodion and dried to make them strong enough for packing.
693	1.49	For every compound of benzene there is an analogous compound of naphthalene.
694	1.45	The general formula for the methane series is C_nH_{2n+2}.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (continued)
695	1.43	Colloids have great power of adsorption, as adsorption of gases by charcoal.
696	1.40	A 40% solution of formaldehyde in water is known as formalin.
697	1.36	The general formula for the ethylene series is C_nH_{2n}.
698	1.29	The Cottrell system for preventing smoke depends upon the neutralization of the electrical charge.
699	1.28	The asphalt from Utah is known as gilsonite and is used for making asphalt varnish or "japan."
700	1.26	Copal, a fossilized gum, obtained from the exudations of tropical trees, is the best of the gums (resins).
701	1.25	Some heterocyclic compounds are pyrrole, thiopene, pyridine, quinoline, indole.
702	1.22	A halogen substitution product is a compound derived from a hydrocarbon by exchanging one or more atoms of hydrogen for a corresponding number of halogen atoms.
703	1.17	Gallic acid is found in a number of plants.
704	1.14	Anthracene is used in preparing anthraquinone which is used in the manufacture of dyes, such as alizarin.
705	1.11	Anthracene is a condensation of three benzene nuclei, and is obtained from coal tar.
706	1.10	Phosgene is a derivative of carbonic acid.
707	1.09	An unsaturated carbon compound contains at least two atoms of carbon that are joined together by more than one bond.
708	0.98	Salicylic acid is both an acid and a phenol, and is prepared from carbolic acid.
709	0.94	Syneresis is the squeezing out of fluids by a gel.
710	0.89	Furfural is prepared from corncobs and is used in the manufacture of synthetic resins, disinfectants, and deodorizers.
711	0.89	An aldehyde is a carbon compound containing CHO.
712	0.88	When petroleum burns it yields 11,000 calories of heat per gram.
713	0.68	Phthalic acid combines with phenol to form phenolphthalein.
714	0.61	An amino acid is a derivative of an organic acid in which one of the

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 1. Carbon (concluded)
714	0.61	(continued) hydrogen atoms is replaced by the amino group (NH_2).
715	0.60	"Tri-cresol" is a mixture of three cresols which are homologs of phenol.
716	0.59	"Ring" or "cyclic" compounds, in which elements other than carbons are present, are known as heterocyclic.
717	0.52	Quinol, thymol, pyrogallol, are phenols.
		2. Silicon and the Others
718	9.06	Various varieties of glass are window, plate, crown, flint, and cut glass.
719	9.00	Pyrex is stronger and tougher than ordinary glass, and will stand considerable change in temperature without cracking.
720	8.05	Sand is used in sandpaper, mortar, and for grinding glass.
721	7.95	Sand and clay are the remains of the chemical weathering of rock.
722	7.07	Glass that is cooled rapidly is hard, brittle, and easily broken.
723	6.79	Enameled bathtubs are cast iron coated with a white lead glass.
724	6.78	Tile, porcelain, and china, are made of pure white clay (kaolin).
725	6.42	Carborundum is extremely hard and is used as a substitute for emery, for grinding and polishing wheels, and for hones.
726	6.37	Common sand is white sand that is discolored by impurities.
727	6.37	Water glass is used to preserve eggs, to make cements, for fireproofing, and as a filter in soaps.
728	6.10	Silicon compounds are used as abrasives, such as sandpaper and sandstone.
729	6.05	White sand is almost pure silicon dioxide.
730	5.61	"Stained glass" is ordinary glass with a thin layer of colored glass on the surface.
731	5.06	Glass is annealed to make it less liable to break under a shock.
732	5.05	Armored glass contains nickel-steel wire which, in case of breakage, will support the pieces.
733	5.03	Enamels are essentially glasses of special composition.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY
		2. Silicon and the Others (continued)
734	5.01	Crown glass is used for window and plate glass, and for bottles.
735	4.96	Bricks are made of ordinary white or yellow clay mixed with sand to prevent shrinkage during heating.
736	4.87	An unglazed vessel of terra cotta, such as a flower pot, is like a brick except in shape.
737	4.56	Glass is an amorphous material commonly made by the fusion of a mixture consisting principally of silicon dioxide, sodium carbonate, and either calcium carbonate or lead oxide.
738	4.47	The green color of common glass is due to iron compounds in the materials used.
739	4.29	Pyrex glass is a borate and silicate of aluminum.
740	4.21	Various forms of silicon dioxide are, quartz, amethyst, onyx, and flint.
741	4.04	The more silica a glass contains the harder it is and the better it resists the attack of chemicals.
742	4.01	Quartz transmits ultra-violet light much better than glass.
743	3.94	Petrified wood has been formed by the gradual replacement of the woody fiber by silica.
744	3.84	Compounds of cobalt give a blue color to glass.
745	3.82	Water glass is made by fusing silica with soda.
746	3.73	Transparent glasses are technically divided into lime and lead glasses.
747	3.72	The color of ruby glass is due to colloidal suspension of gold.
748	3.70	Annealing consists in cooling the glass very slowly by passing it through a long furnace from the hot to the cool end.
749	3.57	Silicon, next to oxygen, is the most abundant element in the earth's crust.
750	3.54	Glass is manufactured by heating the charge in large tank furnaces.
751	3.50	Sponges, quills of feathers, and the finger nails contain considerable silica.
752	3.40	Many glasses owe their appearance to a colloidal condition of various metals.
753	3.34	Vessels made of impure clay turn red due to the formation of ferric oxide during heating.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY
		2. Silicon and the Others (continued)
754	2.95	Silicon dioxide is the most common compound of silicon.
755	2.80	Silicon carbide or carborundum is made by a reaction between silicon dioxide and carbon.
756	2.79	Terra cotta vessels are glazed by throwing salt into the fire of the pottery kiln as the baking nears its end.
757	2.66	Salts of condensed silicic acids, such as feldspar, kaolin, and granite, make up the great bulk of the earth's crust.
758	2.60	The ancient use of straw in the making of bricks implied the action of tannin to stabilize the colloid clay.
759	2.50	Such materials as feldspar and clay are silicates.
760	2.46	The glaze on stoneware is produced by throwing salt into the fire, forming the glass sodium silicate on the surface.
761	2.40	Amber glass owes its color to silver, sulphur, or carbon.
762	2.38	Porcelain and stone china are decorated with specially prepared glasses colored with metallic oxides.
763	2.32	In common clay the kaolin is colored by impurities which are chiefly compounds of iron.
764	2.22	Common stone china is made of white clay mixed with bone ash and fired at a low temperature.
765	2.09	All clays show Brownian movement, and the plasticity of the particular sample depends only upon the amount of colloidal material present.
766	2.03	White glass owes its color to the suspension of some rock, like feldspar or cryolite.
767	2.01	Silicon dioxide combines with oxides at high temperatures to form silicates.
768	2.00	Ceramics is the name given the products of the potter's art: objects molded from clay.
769	1.92	Green glass may be decolorized by manganese dioxide.
770	1.92	$SiO_2 + CaO = CaSiO_3$.
771	1.85	Silicon is formed by heating silicon dioxide with coke.
772	1.82	Opal has nearly the same composition as quartz, but is amorphous.
773	1.79	Acid-proof iron (duriron and tantiron) is cast iron containing 15% silicon.

Number of Item	Index Value	Items
		GROUP IV - A. THE CARBON FAMILY 2. Silicon and the Others (concluded)
774	1.62	Iridescent glass has a surface like mother of pearl.
775	1.62	Opal glass is made by adding cryolite to melted glass.
776	1.59	Slag, formed in the extraction of metals, is due chiefly to the union of the silicon dioxide with calcium oxide.
777	1.47	Vitreosil is fused quartz made into vessels for chemical use.
778	1.38	Silicon is unaffected by ordinary acids, but reacts with potassium hydroxide to liberate hydrogen.
779	1.32	In the manufacture of glass, the alkali silicate acts as a protective colloid, preventing the crystallization of the calcium or lead silicate.
780	1.12	Silicon is used with coke and iron to make the alloy ferro-silicon.
781	1.05	Solution (peptization) of clays is increased by alkalies, and gelation by acids and salts.
782	0.88	Bohemian glass is a calcium-potassium mixture.
783	0.85	Silicon forms two acids, orthosilicic acid and metasilicic acid.
		GROUP IV B. THE TIN FAMILY
784	9.58	Pigments are used in paints to provide color.
785	9.43	Lead is used for pipes and as lining for tanks.
786	8.57	Basic lead carbonate or white lead is the basis of many paints.
787	7.93	A thinner is used to secure proper consistency for the paint.
788	7.92	Tin foil is tin which has been hammered or rolled into thin sheets.
789	7.85	The most important base used in paints is white lead.
790	7.72	All lead compounds are poisonous, and if taken into the system cause serious illness.
791	7.65	Lead is very heavy, soft, and workable.
792	7.53	Metallic surfaces must first be cleaned of rust before painting.
793	7.34	India ink consists of lampblack in colloidal condition.
794	6.45	Alloys of lead are used for type metal, solder, fuse wire, and shot.
795	6.44	A drier is used in paints to hasten oxidation and coagulation.
796	5.89	Lead is the heaviest of the common metals, is soft, and bluish white.
797	5.85	Tin is a white lustrous metal, is soft and malleable, and melts at rather a low temperature.
798	5.85	Solder is an alloy of tin with lead and has a melting point lower than either of its constituents.
799	5.76	Printing inks are practically paints made of the usual pigments.
800	5.72	A paint consists of two essential parts, a liquid called the vehicle or medium, and a solid called the base.
801	5.72	About one-third of the annual production of lead is used in making paint.
802	5.26	Ordinary tinware is sheet iron which has been dipped into melted tin.
803	5.22	Lead acetate, commonly called "sugar of lead" is very poisonous and is used as a medicine.
804	5.22	Next to iron, lead is the cheapest metal.
805	4.46	Outside paint is generally composed of both white lead and zinc oxide ground in oil and mixed with more oil and turpentine before using.
806	4.44	Red lead mixed with linseed oil is used as a cement to make joints tight in gas fitting.
807	4.33	Tin dissolves in concentrated hydrochloric acid.
808	4.29	Bronze contains tin, copper, and often zinc.
809	4.08	Drying oils are used as vehicles in paints because they do not evaporate completely but coagulate to form a protective colloid.
810	4.08	White lead is cheaper and has greater covering power than zinc white, but blackens on exposure.
811	3.84	In using tin vessels they must not be heated above 232 degrees C. or they will melt.
812	3.60	The pigments used in oil paints are all insoluble materials and should be in the colloidal condition.
813	3.20	Lead is nearly always a constituent of the fusible alloys.
814	2.99	Pewter, britannia, babbitt, and the fusible alloys contain tin.
815	2.95	Tin is chiefly available in the oxide form.

Number of Item	Index Value	Items
		GROUP IV - B. THE TIN FAMILY (concluded)
816	2.80	Lead is less active than the other familiar base metals, but may be made to react with the common acids.
817	2.80	Stannous ions are strong reducing agents.
818	2.73	Red lead is known as American vermilion.
819	2.69	Lead chromate is a yellow powder used in dyeing and painting.
820	2.68	A mixture of lead (red) monoxide and glycerine makes an excellent cement for many household purposes.
821	2.52	Cotton goods soaked in a solution of stannic chloride and then in a solution of ammonium sulphate become fireproof.
822	2.51	Lead peroxide forms the active material on the positive plates of the usual type of storage battery.
823	2.47	An extender is used to dilute the pigment in the paint.
824	2.29	Tin is produced by reducing the oxide with carbon.
825	2.21	A drier may be made by boiling some linseed oil and an oxidizing agent like lead or manganese oxides.
826	1.84	Stannic oxide is used in glazing pottery.
827	1.78	Japan drier is a solution in turpentine of lead or manganese linoleate.
828	1.73	Lead occurs principally as the sulphide.
829	1.72	Stannous chloride is made by dissolving tin in concentrated hydrochloric acid.
830	1.60	Lead monoxide is used in the manufacture of glass, and as a pigment.
831	1.34	Lead is refined by roasting the ore and then reducing the oxide.
832	1.27	Tin forms both stannic and stannous salts.
833	1.22	Stannous chloride is used as a mordant by the dyer and calico printer.
834	1.03	Lead monoxide is made by oxidizing melted lead.
835	0.72	Tin disease is the changing of tin at low temperature into a gray powder.
836	0.69	One part of tin rubbed with four parts of mercury makes a plastic mass which sets in a few days.

Number of Item	Index Value	Items
		GROUP V
		B. THE NITROGEN FAMILY
837	13.76	Ventilation is necessary in order to insure the proper amounts of oxygen and carbon dioxide, and correct conditions of temperature and water vapor.
838	11.97	Ammonia is used in refrigeration due to the ease with which it is liquefied and vaporized.
839	11.89	Thermos bottles are constructed on the same principle as the Dewar flask.
840	11.68	Air is a mixture composed chiefly of nitrogen, oxygen, argon, and carbon dioxide.
841	11.53	Ammonia water is used as a cleansing agent to remove grease.
842	11.00	Nitrogen compounds must be added to the soil as fertilizer.
843	10.57	One important use of nitric acid is in the manufacture of nitro compounds, as, T.N.T., nitroglycerine, and nitrobenzene.
844	9.95	Ammonium chloride (sal ammoniac) is used in dry cells and in soldering.
845	9.90	Nitrous oxide, also called laughing gas, is used as an anaesthetic.
846	9.32	Nitrogen-fixing bacteria take nitrogen from the air and make it available to the plants.
847	9.24	A mixture of red phosphorus and ground glass is glued on the side of the safety match box.
848	9.16	The amount of water present in the air relative to the amount necessary to saturate the air under given conditions is known as relative humidity.
849	9.02	Foods rich in phosphorus are, milk, eggs, cereals, and nuts.
850	9.02	Low melting alloys are used for fuses in electrical connections, and for plugs in automatic fire sprinklers in buildings.
851	9.00	Ammonia dissolves in water to form ammonia hydroxide (household ammonia).
852	8.88	A common match consists of wood, paraffin, and a head that is composed of: oxidizing material, a substance with a low kindling temperature, and some material to increase friction.
853	8.53	Nitric acid is used in the manufacture of explosives such as nitroglycerine and guncotton.

Number of Item	Index Value	Items
		GROUP V - B. THE NITROGEN FAMILY (continued)
854	8.49	Ammonia is a colorless gas with a characteristic pungent odor.
855	8.39	Nitrogen is an essential constituent of proteins.
856	7.95	Phophine is very poisonous and has been used in gas warfare.
857	7.66	White phosphorus is spontaneously inflammable when exposed to air.
858	7.57	The reddish stains produced upon the clothing by hydrochloric acid and by dilute sulphuric acid can be removed by neutralizing the acid with dilute ammonia water.
859	7.42	Phosphorus compounds are an important constituent of the bones, teeth, muscles, and nerves of animals.
860	7.41	Nitrogen is abundant in compounds such as food, explosives, and fertilizers.
861	7.40	Our nitrogen fertilizers come chiefly from Chile saltpeter, and as a by-product in the manufacture of coke.
862	7.40	The head of a safety match is composed of antimony sulphide and potassium chlorate.
863	7.33	A phosphorus burn is a poisonous wound which heals with great difficulty.
864	7.17	Pure dry ammonia is not an active substance, but its water solution is a strong base.
865	7.14	Nitric acid is used to etch metals from which to print a large number of copies.
866	6.60	The cloud of phosphorus pentoxide from burning phosphorus furnishes the best smoke screen to protect naval vessels.
867	6.50	Match sticks are sometimes impregnated with a fireproofing material to prevent smouldering.
868	6.44	Ammonium nitrate was used in the war for explosive mixtures.
869	6.24	Phosphorus "sesquisulphide" is used in the manufacture of matches.
870	6.12	Nitric acid causes proteins, like the skin, to turn yellow.
871	6.06	The nitrates of sodium and potassium are the only ones found in nature in considerable quantity.
872	6.05	Nitrogen constitutes four-fifths of the atmosphere.
873	5.99	Nitric acid is used in the manufacture of dyes, films, rayon, and celluloid.
874	5.96	A minute quantity of white phosphorus taken internally causes death.
875	5.94	Ammonium sulphate is used as a fertilizer.
876	5.85	Nitric acid is very strong, and a powerful oxidizing agent.
877	5.62	Gold and platinum are attacked by aqua regia.
878	5.38	White phosphorus is very reactive and unites with oxygen in the cold with the liberation of a pale light.
879	5.23	White phosphorus is insoluble in water, but soluble in turpentine, olive oil, and carbon disulphide.
880	5.19	Hydrogen cyanide is one of the most poisonous compounds known, and is used to destroy insects.
881	5.00	Ammonium chloride is employed to remove films of rust from metallic surfaces before soldering.
882	4.97	Nitrogen is slightly lighter than air and is without color, odor, or taste.
883	4.95	Ammonium chloride is used in calico printing, in dyestuffs, and in medicines.
884	4.88	Ammonia is lighter than air and very soluble in water.
885	4.85	Brass turns yellow when nitric acid is added to it.
886	4.81	Aqua regia is a mixture of nitric and hydrochloric acids.
887	4.75	Two common alloys of bismuth are Wood's metal and Rose's metal.
888	4.72	Arsenic is added to lead in the manufacture of shot to lower the melting point of the alloy and make the shot harder.
889	4.71	Ammonium bromide and ammonium iodide are employed in photography.
890	4.63	Red phosphorus is obtained when white phosphorus is heated to 232 degrees C. in the absence of air.
891	4.56	Ammonia is commonly produced in the laboratory by a reaction between an ammonium salt and a base.
892	4.56	Antimony is used in alloys, for bearings, type metal, and babbitt.
893	4.50	Phosphorus exists in two allotropic forms--the white and the red.
894	4.44	The fixation of nitrogen is the formation of useful compounds by causing the free nitrogen of the air to unite with other elements.

Number of Item	Index Value	Items
		GROUP V - B. THE NITROGEN FAMILY (continued)
895	4.43	Phosphoric acid is used in calico printing, in rustproofing iron and steel, and as "acid phosphate" in beverages.
896	4.34	Nitrogen can be made to combine with a number of the metals to form nitrides, as magnesium nitride.
897	4.27	Liquid air is used for the production of oxygen and nitrogen, the basis of the separation being the difference in boiling points.
898	4.26	When ferrous sulphate and concentrated sulphuric acid are added to a substance containing a nitrate a brown ring appears just above the sulphuric acid.
899	4.24	The red form of phosphorus is more stable than the white form.
900	4.22	Liquid air is kept in vacuum bottles.
901	4.20	Nitric acid may be prepared by heating a mixture of sulphuric acid and sodium nitrate.
902	4.18	Liquid air is blue and its temperature is -192° C.
903	4.16	Ammonia is produced by the destructive distillation of coal.
904	4.15	Paris green is a copper and arsenic compound used as a pigment and insecticide.
905	4.05	Important alloys of antimony are, Britannia metal, Babbitt metal, shrapnel, and type metal.
906	4.02	Nitric acid is a solution of hydrogen nitrate in water.
907	3.94	Nitrogen may be prepared by removing the other constituents of the air, or by decomposing ammonium nitrite by heating.
908	3.94	Nitric acid is used in making nitrates such as, silver nitrate, lead nitrate, etc.
909	3.78	Nitric acid decomposes on standing into nitrogen peroxide which gives the acid a yellow color.
910	3.70	The valence of phosphorus may be three or five.
911	3.67	Nitrogen oxide becomes peroxide when exposed to air.
912	3.66	Nitrogen is prepared in the laboratory by burning phosphorus in air.
913	3.63	Red phosphorus is much denser than the white variety, is insoluble in carbon disulphide, and unaffected by air at ordinary temperatures.
914	3.62	Phosphorus when a constituent of iron and steel injures the metal, making it brittle and worthless.
915	3.54	Phosphor bronze is a hard, tenacious alloy.
916	3.43	All of the nitrates are freely soluble in water.
917	3.42	Nitric oxide is made by the action of dilute nitric acid upon copper.
918	3.40	White phosphorus is a colorless, transparent, waxy solid which melts at 44 degrees, boils at 287 degrees, and has a specific gravity of 1.83.
919	3.35	Ammonia can be prepared by the passage of sparks through a mixture of hydrogen and nitrogen, or by employing a catalytic agent.
920	3.35	A mixture of red phosphorus and potassium chlorate explodes with a loud report when struck with a hammer.
921	3.34	"Ammonia" stands for NH_3, a gas, and is distinguished from ammonium, NH_4, which acts like a metal.
922	3.22	Pure nitric acid is a colorless, fuming liquid, of specific gravity 1.5.
923	3.21	Ammonia is a basic anhydride.
924	3.20	Nitrogen may be liquefied and solidified.
925	3.19	Phosphorus is made by heating a mixture of phosphate rock with coke and sand by means of an electric spark.
926	3.15	The various oxides of nitrogen illustrate the law of multiple proportion.
927	3.13	The oxides of nitrogen are, nitrous oxide, nitric oxide, nitrous anhydride, nitrogen peroxide, nitric anhydride, nitrogen trioxide, and nitrogen pentoxide.
928	3.12	Ammonia is produced by the cyanide synthetic process.
929	3.10	When protoplasm decays the gas formed is ammonia.
930	3.09	Nitrous oxide, if decomposed, will support combustion.
931	3.09	The only important ore of antimony is stibnite, which is antimony sulphide.
932	3.05	Prussic acid is a solution of hydrogen cyanide in water.
933	2.95	Gases are liquefied on a commercial scale by "self-intensive" cooling.
934	2.86	Nitric acid is prepared by oxidizing ammonia in the presence of a catalytic agent (Oswald process).
935	2.86	Faraday was the first to attack the problem of liquefaction of air in a systematic way.

Number of Item	Index Value	Items
		GROUP V - B. THE NITROGEN FAMILY (continued)
936	2.83	When an ammonium salt is heated with a base, ammonia will be liberated and the salt thus identified.
937	2.71	The chief source of phosphorus for artificial fertilizer is the phosphate rock found in Florida, Alabama, and North Africa.
938	2.69	Phosphorus pentoxide combines with water to form phosphoric acid.
939	2.65	Sodium phosphate is used in medicine.
940	2.65	Antimony does not tarnish in air.
941	2.65	The chief use of arsenious oxide is in the preparation of such insecticides as Paris green, London purple, lead arsenate.
942	2.62	Nitrogen does not combine readily with many substances, and its compounds are easily decomposed.
943	2.51	Bismuth and antimony expand when cooling.
944	2.45	The ammonium group, NH_4, has never been isolated.
945	2.37	Nitrogen, phosphorus, arsenic, antimony, and bismuth constitute a chemical family.
946	2.34	When nitric acid reacts with metals the gases that are given off are the reduction products of nitric acid.
947	2.21	Liquid antimony expands when it cools and imparts this property to alloys containing it.
948	2.21	The nitrates of the alkali metals are white soluble salts.
949	2.18	The old name of ammonia was "spirits of hartshorn."
950	2.08	"Ammonal" which is an explosive, is a mixture of ammonium nitrate and T.N.T.
951	2.07	Nitrous acid is prepared from sodium nitrite and sulphuric acid.
952	2.07	Phosphorus is made available for plant use by treatment of the phosphate rock with sulphuric acid.
953	2.03	Bismuth alloys are remarkable for their low melting points.
954	2.01	Common salts of ammonia are, ammonium sulphate, ammonium chloride, ammonium nitrate.
955	1.97	Aqua regia owes its action to the nascent (or atomic state) chloride which is liberated by the interaction of the two acids.
956	1.95	Monocalcium acid phosphate is used in baking powders and fertilizers.
		GROUP V - B. THE NITROGEN FAMILY (concluded)
957	1.92	Arsine corresponds to ammonia and is a highly poisonous gas.
958	1.92	Our supply of bismuth comes chiefly from Bolivia.
959	1.88	Arsenic resembles the metals in physical properties and the nonmetals in chemical properties.
960	1.82	Ammonium chloride is formed from ammonia and hydrogen chloride, and from "gas liquor."
961	1.80	Antimony is a silver-white, crystalline, brittle solid.
962	1.60	Arsenious oxide may be detected by the strong odor of garlic when it is vaporized.
963	1.59	Bismuth resembles antimony, but is more metallic.
964	1.54	Bismuth subnitrate is made by dissolving bismuth in nitric acid and pouring the solution into water.
965	1.44	The fixation of atmospheric nitrogen in nitric acid is carried out chiefly in Norway by the Birkland-Eyde process.
966	1.39	Bismuth is prepared by smelting the sulphide with iron and reducing the oxide with carbon.
967	1.37	The best antidote for arsenious oxide is ferric hydroxide.
968	1.32	Bismuth subnitrate and bismuth oxychloride are insoluble powders and much used as cosmetics.
969	1.03	The ores of bismuth contain the native metal mixed with bismuth sulphide.
970	1.02	Arsenious oxide, (white arsenic) is a rather heavy white solid.
971	0.94	Arsenic is found in nature combined with sulphur.
972	0.84	Antimony is obtained by heating stibnite with iron scrap.
973	0.78	Arsenious oxide is chiefly obtained as a by-product in the smelting of nickel ores.
974	0.70	Arsenic is made by heating arsenopyrite and then condensing the vapor.
		GROUP VI
		A. THE CHROMIUM FAMILY
975	9.73	Tungsten filament lamps are three times as efficient as the older carbon lamps.

Number of Item	Index Value	Items
		GROUP VI - A. THE CHROMIUM FAMILY (continued)
976	9.42	Much tungsten is used to make filaments for electric light bulbs.
977	9.08	Chromium is now being electroplated commercially on base metals, as radiators, and headlamps for cars.
978	7.15	Chromium is practically tarnish-proof and imparts this property to articles protected by it.
979	5.75	"Chrome steel" is used for safes, ball bearings, armor plate, gears, and knives.
980	5.49	Tungsten is used in the making of high-speed tool steel.
981	5.25	Chromium is a hard, brittle, silvery metal.
982	4.26	Tungsten has replaced platinum in dental work, electrical contacts in switches, and X-ray tubes.
983	3.96	Tungsten is a gray lustrous metal with high specific gravity and a very high melting point.
984	3.72	Lead chromate, known as chrome yellow, is used as a pigment.
985	3.44	Tungsten is intensely hard, and quite unaffected by water and the ordinary acids.
986	3.25	All chromates and dichromates are very poisonous.
987	3.21	Chromium imparts great hardness to steel to form "chrome steels."
988	3.16	When small quantities of chromium are added to steel the tenacity and hardness are increased.
989	2.91	Nichrome is an alloy of nickel and chromium and is much used for electrical resistance heaters.
990	2.72	All chromium compounds are colored.
991	2.36	Chromium dissolves in hydrochloric acid but is unaffected by nitric acid.
992	2.32	Compounds of uranium are used in making glass for automobile lenses.
993	2.01	Uranium and all of its compounds give off rays which affect photographic plates and charge the air electrically.
994	1.82	Potassium dichromate is employed in tanning, as a mordant, and in lithography.
995	1.65	Sodium dichromate is replacing potassium dichromate in dyeing and tanning because it is cheaper.
996	1.63	Chromium is prepared by reducing the oxide with aluminum.
997	1.59	"Chrome oxide" is a green powder used for painting on china and for coloring bank notes.
998	1.57	Chromium acts both as a base-forming and as an acid-forming element.
999	1.40	Ferro-chrome is made by smelting chromite with iron and coke in an electric furnace.
1000	1.36	Potassium chromate and potassium dichromate are common chromium compounds.
1001	1.26	Uranium resembles nickel in appearance, but is more than twice as dense.
1002	1.25	The most important mineral containing chromium is chromite, or chrome iron ore.
1003	1.22	The two important oxides of chromium are chromic oxide and chromic anhydride.
1004	1.11	Uranium has the highest atomic weight of all the elements.
1005	1.07	Compounds of molybdenum are used for dyeing silk, wool, and leather.
1006	0.91	Chromium hydroxide is a greenish compound, and is used in tanning.
1007	0.91	Potassium chromate is bright lemon-yellow and is freely soluble in water.
1008	0.80	Potassium dichromate has an oxidizing action.
1009	0.74	Molybdenum is similar to tungsten and is used in making molybdenum steel.
1010	0.55	Sodium dichromate is made by heating chrome iron ore with sodium carbonate and lime.
		GROUP VI - A. THE CHROMIUM FAMILY (concluded)
		GROUP VI
		B. THE OXYGEN FAMILY
1011	13.42	Oily rags or green hay may cause a fire by spontaneous combustion.
1012	12.59	Rust and decay are slow oxidation processes.
1013	12.00	A blue gas flame is hottest because the gas has been more completely oxidized.
1014	11.11	A substance must be heated to its kindling temperature before it will burn.
1015	11.02	The liberation of light and heat as a result of chemical action is called combustion.
1016	10.65	When sulphuric acid is placed on the skin it burns, due to the fact that it adsorbs the moisture from the flesh.

Number of Item	Index Value	Items
		GROUP VI - B. THE OXYGEN GROUP (continued)
1017	10.46	Sulphur is used in making matches.
1018	10.23	Oxygen has a great tendency to combine with many other elements.
1019	10.08	A chemical action in which a substance unites with oxygen is called oxidation.
1020	9.48	Oxygen is colorless, odorless, and tasteless.
1021	8.90	The presence of hydrogen sulphide in the air causes silverware to tarnish.
1022	8.86	The high temperatures produced in the oxyhydrogen and oxyacetylene flames are used to cut and weld metals.
1023	8.66	An oxide is a compound of oxygen and another element.
1024	8.32	The peculiar odor of rotten eggs is that of hydrogen sulphide which has formed in the decaying process.
1025	8.15	When Lavoisier heated the red powder which he had obtained, a gas was given off which he called oxygen.
1026	8.17	Hydrogen peroxide is used as a bleaching and disinfecting agent.
1027	7.92	Plants and animals use oxygen to oxidize the various tissues and so liberate heat.
1028	7.83	Wool, silk, and hair are bleached by the oxidation of their coloring matters with hydrogen peroxide.
1029	7.34	Oxygen is the most abundant element in the earth's crust.
1030	7.10	When sulphuric acid is added to water heat is evolved.
1031	7.05	Water tastes "flat" when the oxygen has been removed by boiling.
1032	6.51	Harmful bacteria are destroyed by the oxidizing action of hydrogen peroxide.
1033	6.21	Oxygen dissolves in water.
1034	6.09	Sulphur dioxide is used in bleaching and disinfecting.
1035	5.97	Hydrogen peroxide owes its value to the oxygen set free.
1036	5.80	Sulphur is used as a constituent of sprays for trees.
1037	5.75	Materials that supply oxygen are known as oxidizing agents.
1038	5.74	Lavoisier obtained a red powder by heating mercury in air.
1039	5.59	Dust explosions in mines and mills are caused by rapid oxidation of the small dust particles with the liberation of heat.
1040	5.38	Hydrogen sulphide arises from decaying food.
1041	5.04	When sewage is sprayed into the air oxygen comes in contact with it and purifies it.
1042	4.78	The colors of many paints are caused by using metallic sulphides.
1043	4.73	The air is about one-fifth oxygen by volume.
1044	4.69	Oxygen is prepared commercially by the electrolysis of water.
1045	4.58	Some substances, like sulphur, burn in oxygen with dazzling brilliancy.
1046	4.58	Sulphur is moderately active and joins with many metals.
1047	4.48	Zinc and dilute sulphuric acid react together to liberate hydrogen.
1048	4.39	Sulphur is found in nature in both the free and combined states.
1049	4.33	Sulphur is used in vulcanizing rubber.
1050	4.18	A safety lamp scatters the heat so that the gases, which might explode, are always below their kindling temperature.
1051	3.71	Oxygen may be liquefied and solidified by cooling and increasing the pressure.
1052	3.65	"Sulphur water" is due to dissolved hydrogen sulphide.
1053	3.40	Oxygen is prepared commercially from liquid air.
1054	3.40	Hot concentrated sulphuric acid acts as an oxidizing agent.
1055	3.39	Ozone is a form of oxygen.
1056	3.37	The atomic weight of oxygen is 16.
1057	3.27	Oil of Vitriol is the commercial name of sulphuric acid.
1058	3.18	Sulphur is extracted from beneath beds of quicksand by forcing hot water and air down through pipes to melt the sulphur and bring it to the surface.
1059	3.18	Sulphuric acid is used in the preparation of other acids.
1060	3.00	$S + O_2 = SO_2$.
1061	2.90	Oxygen is usually prepared in the laboratory by heating potassium chlorate.
1062	2.89	The pickling of metals so that paint will adhere to them may be done with sulphuric acid.
1063	2.83	Carbon disulphide is highly inflammable and is used as a solvent for gums and waxes.
1064	2.78	Sulphur and highly heated carbon unite to form carbon disulphide.
1065	2.74	Sulphur dioxide may be both an oxidizing and reducing agent.

Number of Item	Index Value	Items
		GROUP VI - B. THE OXYGEN GROUP (concluded)
1066	2.73	The commercial forms of sulphur are roll sulphur and flowers of sulphur.
1067	2.67	Hydrogen sulphide reacts with some metals to form sulphides.
1068	2.67	The equation for the electrolysis of water is $2\ H_2O = 2\ H_2 + O_2$.
1069	2.30	Hydrogen sulphide acts as a strong reducing agent.
1070	2.19	Sulphuric acid has a high specific gravity.
1071	2.13	Oxygen was first obtained by heating a red powder, (mercuric oxide).
1072	2.08	Selenium imparts a red color to glass.
1073	2.04	Sulphuric acid is prepared by the contact and chamber processes.
1074	2.02	Selenium is used in automatic fire extinguishers because it is only a conductor when exposed to light.
1075	1.93	The first discovery of oxygen is usually credited to Priestley in 1774.
1076	1.92	$FeS + 2\ HCl = FeCl_2 + H_2S$.
1077	1.84	Hydrogen sulphide in water is a weak acid.
1078	1.78	The allotropic forms of sulphur are monoclinic, rhombic, amorphous.
1079	1.43	Sulphur is extracted in Louisiana by the Frasch method.
1080	1.29	Rhombic sulphur is the most stable form, and at ordinary temperatures monoclinic and amorphous sulphur change to the rhombic form.
1081	1.18	The acid anhydride of sulphurous acid is sulphur dioxide.
1082	1.16	Twenty volumes of water vapor would yield ten volumes of oxygen.
1083	1.13	$H_2SO_4 + SO_3 = H_2SO_4 \cdot SO_3$.
1084	1.05	The test for the sulphate ion is the insolubility of barium sulphate.
1085	0.96	Sulphur dioxide is formed by a reaction between sodium sulphite and dilute sulphuric acid.
1086	0.88	The weight of 22.4 liters of oxygen at standard conditions is 32 grams.
1087	0.67	4.2 lbs. of oxygen are required to completely oxidize 10 pounds of iron ($4\ Fe + 3\ O_2 = 2\ Fe_2O_3$.)
1088	0.46	An acid of sulphur is persulphuric acid, $H_2S_2O_8$.

Number of Item	Index Value	Items
		GROUP VII
		A. THE MANGANESE FAMILY
1089	3.43	Potassium permanganate is used in bleaching, in dyeing, and as a gargle.
1090	2.66	The most important compound of manganese is the dioxide, MnO_2.
1091	2.45	Manganese steel is tough and tenacious.
1092	2.38	Potassium permanganate is a powerful oxidizing agent.
1093	2.08	Manganese bronze is very tenacious and is employed for the propellers of steamships.
1094	2.05	Manganese rusts in moist air, liberates hydrogen slowly from water when heated, and dissolves easily in acids.
1095	2.04	Manganese bronze is an alloy of copper, tin and manganese.
1096	2.01	Manganese dioxide is essential as a depolarizer in dry cells.
1097	1.97	Manganese is a hard metal resembling steel in appearance.
1098	1.81	Manganese displays both metallic and non-metallic properties.
1099	1.03	Manganese occurs in its salts as a constituent of the negative ion.
1100	0.95	Potassium permanganate is used as a disinfectant under the name "Condy's fluid."
1101	0.88	Manganese is prepared by reducing the oxide, and by the thermite process.
1102	0.83	The most important ore of manganese is pyrolusite.
1103	0.80	Spiegeleisen or specular pig iron is an alloy containing 15-20 per cent manganese.
1104	0.70	Potassium permanganate is made by melting manganese dioxide with potassium hydroxide and potassium chlorate at a low heat.
1105	0.67	Ferro-manganese contains up to 70% manganese.
1106	0.63	Manganese dioxide is usually made by powdering a pure grade of pyrolusite.

Number of Item	Index Value	Items
		GROUP VII
		B. THE HALOGENS
1107	13.53	Tincture of iodine is used for reducing swellings, and as an antiseptic for cuts of the skin.
1108	12.75	Much chlorine is used in purifying our drinking water.
1109	12.12	Chloroform is an important anaesthetic.
1110	10.41	The chief uses of chlorine are in disinfecting and bleaching.
1111	10.11	A solution of iodine in alcohol is called tincture of iodine.
1112	10.04	Goiter appears to be due to a deficiency of iodine.
1113	9.89	The chief use of fluorine is in the etching of glass, such as electric light bulbs.
1114	8.88	Chlorine is a poison gas and was used as such during the World War.
1115	8.36	The water solution of hydrogen chloride is known as hydrochloric acid.
1116	8.12	Chlorine reacts with sodium to form common salt, sodium chloride.
1117	7.65	Iodine compounds are used in medicine, in photography, and for dyeing.
1118	6.93	Bromine and fluorine cause severe irritation of the skin if allowed to come in contact with it.
1119	6.71	The natural state of bromine is a dark reddish-brown liquid, about three times as dense as water.
1120	6.42	Hydrochloric acid is used in cleaning metals.
1121	6.11	Iodine gives a blue color with starch paste.
1122	6.07	A small amount of hydrochloric acid is present in the digestive juices of the stomach.
1123	6.00	Chlorine in the form of bleaching powder, liquid chlorine, or Javelle water, is used for bleaching.
1124	5.90	Chlorine is used with slaked lime to form chloride of lime or bleaching powder.
1125	5.77	Chlorine cannot be used to bleach silk and wool as it destroys the fibers.
1126	5.72	When iodine is warmed it passes directly into a violet vapor.
1127	5.71	Bromine has an odor resembling chlorine.
1128	5.69	Hydrofluoric acid is kept in bottles made of wax, because it acts on glass.
1129	5.26	Iodine is a shining purplish-black solid.
		GROUP VII - B. THE HALOGENS (continued)
1130	5.26	Bromine is used in certain drugs and dyes.
1131	5.13	Hydrochloric acid reacts with many metals, such as zinc, to produce a chloride and hydrogen.
1132	5.03	Chlorine is prepared by the electrolysis of common table salt.
1133	4.87	Solutions of iodine in carbon disulphide or chloroform possess a violet color.
1134	4.73	The elements chlorine, bromine, and iodine form a chemical family known as the halogens (salt formers).
1135	4.64	The liquid chlorine of commerce is distributed in cylinders.
1136	4.63	At ordinary temperatures fluorine is a nearly colorless gas and much more poisonous than chlorine.
1137	4.56	The natural state of iodine is a steel gray solid.
1138	4.48	The commercial name of hydrochloric acid is "muriatic acid."
1139	4.45	Water vapor acts as a catalyst in the reactions of chlorine.
1140	4.40	The molecule of hydrogen chloride contains one atom of hydrogen to one atom of chlorine, and its simplest formula is HCl.
1141	4.40	Chlorine is collected by downward displacement of air.
1142	4.32	Bromine combines directly with many elements to form bromides, but is not as active as chlorine.
1143	4.26	Inhaling alcohol or ammonia counteracts the effect of chlorine upon the respiratory system.
1144	4.22	Fluorine is the most active of the halogens and will replace any of the other three in their compounds.
1145	4.19	Hydrogen will burn in chlorine, forming white fumes called hydrogen chloride.
1146	4.19	The chief use of bromine is in making ethylene bromide which is a constituent of "ethyl gasoline."
1147	4.12	Cooled iodine vapor passes directly into the solid state, and is an example of sublimation.
1148	4.08	Hydrochloric acid is used in the manufacture of glue, gelatine, and glucose.
1149	4.07	Iodine in the form of thyroxin is used by the body to regulate the oxidation of the food.
1150	3.85	Hydrogen combines with chlorine to form hydrogen chloride.

Number of Item	Index Value	Items
		GROUP VII - B. THE HALOGENS (continued)
1151	3.81	Chlorine is very active and joins directly with many metals to form chlorides.
1152	3.74	Chlorine is a greenish-yellow gas.
1153	3.74	The silver nitrate test, together with the litmus test, serves to identify hydrochloric acid.
1154	3.73	Hydrogen chloride is found in the gases that issue from volcanoes.
1155	3.60	Chlorine is a good oxidizing agent, reacting with water to form oxygen which, set free, combines with the substance to be oxidized.
1156	3.53	Hydrogen chloride may be prepared by the direct combination of hydrogen and chlorine.
1157	3.51	Silver chloride is used as an ore of silver.
1158	3.51	The properties of the halogens change in a definite way with the change of atomic weight.
1159	3.50	Chlorine is used in making carbon tetrachloride, chloroform, and sulphur chloride.
1160	3.48	The bleaching and disinfecting action of chlorine is due to its compound, hypochlorous acid.
1161	3.43	The water solution of hydrogen chloride has all of the properties of an acid.
1162	3.42	The halogen acids are reducing agents.
1163	3.41	When chlorine water is exposed to sunlight, hydrogen chloride and oxygen are produced.
1164	3.36	The principal sources of chlorine are sodium, potassium, and silver chlorides.
1165	3.32	Javelle water is used for removing fruit and other stains.
1166	3.28	The white mist or fumes noticed near bottles of hydrochloric acid is caused by the condensing of the moisture in the air by the highly soluble hydrogen chloride gas.
1167	3.25	Chlorine is used in the extraction of gold by the "chlorination process."
1168	3.25	Iodine occurs in deposits of impure sodium nitrate.
1169	3.19	Chlorine will replace the iodine in an iodide.
1170	3.17	Chlorine will replace the bromine in a bromide.
1171	3.10	The test for a bromide is to add chlorine water to a solution of a bromide and then shake with chloroform. The free bromine will

Number of Item	Index Value	Items
		GROUP VII - B. THE HALOGENS (continued)
1171	3.10	(continued) dissolve in the chloroform to give it the characteristic orange color.
1172	3.09	$NaCl + H_2SO_4 = NaHSO_4 + HCl$.
1173	3.08	Iodine and phosphorus react violently to form phosphorus iodide.
1174	3.06	Iodine resembles chlorine in chemical conduct, but is less active than bromine.
1175	3.06	Bromine is the only liquid non-metallic element.
1176	3.05	Bromine salts are usually found as impurities in other salt beds in the U. S. and Germany.
1177	3.04	Bromine is very soluble in water to form bromine water.
1178	2.85	The halogen acids may be prepared by the action of sulphuric acid on the corresponding salt.
1179	2.83	The salts of hydrobromic acid are known as bromides.
1180	2.81	Bromine is prepared commercially by treating the bromide with chlorine.
1181	2.81	Chlorine dissolves in water to produce chlorine water.
1182	2.76	Sulphur chloride is used in vulcanizing rubber.
1183	2.70	Chlorine is very active because it only needs one electron to complete its outer shell.
1184	2.67	Iodine is prepared from sodium iodide and chlorine.
1185	2.60	The Nelson cell is used for the manufacture of chlorine and caustic soda (sodium hydroxide).
1186	2.58	Hot copper foil burns brilliantly in chlorine to form chloride of copper.
1187	2.55	Bromine dissolves in water to form bromine water.
1188	2.52	The properties of the halogens change in a definite way with the change of the atomic weight.
1189	2.46	Equal volumes of hydrogen and chlorine are obtained by the electrolysis of hydrochloric acid.
1190	2.38	Iodine was discovered in the ashes of sea plants by Courtois in 1812.
1191	2.29	One volume of water under standard conditions will dissolve about 500 volumes of hydrogen chloride.
1192	2.29	Sir Humphrey Davy, in 1809, proved chlorine to be an element.
1193	2.25	The halogen elements are usually univalent.
1194	2.14	In testing for an iodide, add chlorine water and carbon disulphide and then shake. A violet color

Number of Item	Index Value	Items
		GROUP VII - B. THE HALOGENS (continued)
1194	2.14	(continued) indicates the presence of free iodine.
1195	2.14	The salts of hydriodic acid are called iodides.
1196	2.14	Fluorine was obtained by electrolyzing hydrogen fluoride.
1197	2.13	Bromine will replace the iodine in an iodide, but not as easily as chlorine.
1198	2.09	The final products of the electrolysis of sodium chloride are chlorine and sodium hydroxide.
1199	2.08	Silver, mercurous, and lead chlorides are insoluble in hydrochloric acid.
1200	2.01	The oxidation of hydrochloric acid yields chlorine.
1201	1.93	Iodides have a lower heat of formation than the bromides, chlorides, or fluorides, and hence iodine may be replaced by each of the three mentioned.
1202	1.92	Dakin's and Carrel's solutions are used for cleansing wounds.
1203	1.90	Hydrobromic acid is a water solution of hydrogen bromide.
1204	1.90	Compounds of bromine are found especially in the salt waters of Michigan and the Ohio River Valley.
1205	1.88	Chlorine was discovered by Scheele in 1774.
1206	1.87	Hydrogen bromide is prepared by a reaction between dilute sulphuric acid and a solution of potassium bromide.
1207	1.86	Hydrogen iodide is a colorless gas whose water solution is called hydriodic acid.
1208	1.86	The atomic weight of chlorine is 35.5.
1209	1.85	Hydrogen chloride is denser than air and may be liquefied and solidified at low temperature with increased pressure.
1210	1.77	Two compounds of fluorine that occur in nature are fluorite and cryolite.
1211	1.75	Hydrogen chloride is commonly prepared by a reaction between sodium chloride and sulphuric acid.
1212	1.71	Chlorine will combine with the hydrogen in such compounds as wax or turpentine and a deposit of soot (carbon) is formed.
1213	1.57	Dry hydrogen chloride is rather inert chemically.
1214	1.55	Metals having insoluble chlorides do not react with hydrochloric acid.
		GROUP VII - B. THE HALOGENS (concluded)
1215	1.54	Chlorine supports combustion, as when antimony reacts with it producing sparks and smoke.
1216	1.32	Ordinary hydrochloric acid has a density of 1.2 (concentrated).
1217	1.20	Javelle water is a solution of sodium hypochlorite.
1218	1.11	Bromine was discovered in 1826 by Ballard.
1219	0.93	The purpose of the diaphragm in the Nelson cell is to prevent the mixing of the chlorine and the sodium hydroxide solution.
1220	0.86	The common valence of chlorine is minus one.
1221	0.85	Bromine boils at 58.7 degrees and freezes at -7.2 degrees Centigrade.
		GROUP VIII
		A. THE IRON FAMILY
1222	9.70	Foods rich in iron are lean meat, raisins, and spinach.
1223	9.69	In this country the steel is carried for refining to the furnaces near such steel centers as Pittsburgh and Chicago.
1224	9.02	Iron compounds are necessary in the diet.
1225	8.22	Blue prints are a much used method of showing diagrams and other records.
1226	7.95	Ordinary welding is the process of joining two pieces of steel by heating the surfaces to be joined until they soften, and then causing them to join by pressure or hammering.
1227	7.81	Nickel is used as a covering for other metals.
1228	7.39	Rust stains may be removed by washing with dilute vinegar, lemon juice, or oxalic acid.
1229	7.01	The proper amount of chromium produces the stainless and rustproof steel and iron used for knife-blades.
1230	6.76	Cast iron is used for metal objects, such as stoves and machinery, which are not subject to shock or tension.
1231	6.72	Nickel is a hard metal, is malleable, and resembles silver in color.
1232	6.60	Nickel is capable of receiving and retaining a very high polish.

Number of Item	Index Value	Items
		GROUP VIII - A. THE IRON FAMILY (continued)
1233	6.35	The red and yellow colors of soils are generally due to oxides of iron.
1234	6.31	The chief processes used to remove the impurities from iron and convert it into special steels are, puddling, Bessemer process, open hearth, and electric furnace.
1235	6.30	Crucible steel is used in making fine-edged tools, and springs.
1236	6.17	Nickel is used as a constituent of alloys such as nickel steel, nickel coins, and monel metal.
1237	6.13	Iron occurs in the form of haemoglobin in the red blood cells.
1238	6.08	The United States produces about one half of the world's iron.
1239	5.95	The iron which comes from the blast furnace may be cast into small ingots called pigs.
1240	5.81	We have enormous deposits of iron in Minnesota, Michigan, and Alabama.
1241	5.68	Wrought iron is used for pipe, bolts, wire, horseshoes, etc.
1242	5.45	The degree of hardness of the steel may be controlled by regulating the rate of cooling from 700 degrees C.
1243	5.44	Blast furnaces are kept in continuous operation until necessary to make repairs.
1244	5.26	Cast iron is converted into high grade forms of iron or steel by refining.
1245	4.95	Cast iron cannot be welded or forged.
1246	4.79	Steel contains varying amounts of carbon, and in addition may contain varying amounts of other metals to give it special properties.
1247	4.73	Nickel steel is used for axles, bridges, and automobile parts.
1248	4.69	Steels are alloys which are colloidal solutions of metals.
1249	4.66	Blue prints owe their color to the formation of Turnbull's blue.
1250	4.47	Iron ore occurs chiefly in the form of compounds, the principal ore being iron oxide.
1251	4.43	The magnetic oxide of iron occurs in nature as magnetite, which when found naturally magnetized is known as loadstone.
1252	4.40	Blue prints are made on paper coated with a ferric salt, potassium ferricyanide, and a reducing agent.
1253	4.32	The iron is heavier than the slag and sinks to the bottom of the furnace from which it is drawn off through a tap hole.
1254	4.32	Free iron occurs in nature only in meteorites.
1255	4.22	Wrought iron is one of the commercial forms of pure iron.
1256	4.21	Steel containing copper resists the weather better than ordinary steel.
1257	4.19	Ink is a colloidal solution of ferrous and ferric tannate, protected by gum arabic.
1258	4.05	Permanent writing fluids usually contain ferrous tannate which oxidizes to an insoluble black precipitate.
1259	4.00	Wrought iron may be welded but not hardened.
1260	3.88	The electric furnace is used to produce high-grade steel from low-grade materials.
1261	3.85	There is more iron in the world than any other metal except aluminum.
1262	3.72	Iron ore is smelted by using: carbon to reduce the ore; and a flux, such as lime to separate the other materials.
1263	3.72	Rouge is used for polishing and as a pigment.
1264	3.63	Nickel wires are used to conduct the current through the glass of incandescent lamps.
1265	3.62	Open-hearth steel is used for machinery, guns, girders, etc.
1266	3.55	Copper, tin, zinc, and nickel, are the chief metallic protective agents used for iron.
1267	3.53	The best black inks are made by a reaction between ferrous sulphate and tannic acid with the production of ferric tannate.
1268	3.52	"Monel metal" is hard, tenacious, rustproof, and resists corrosion.
1269	3.47	The sources of nickel are complex minerals, chiefly sulphides and arsenides.
1270	3.37	Most steel furnaces have a basic lining to assist in removing sulphur and phosphorus.
1271	3.31	If tinware once exposes a spot of iron the corrosion proceeds rapidly; whereas with zinc the protection lasts while there is yet a bit of zinc remaining.

Number of Item	Index Value	Items
		GROUP VIII - A. THE IRON FAMILY (continued)
1272	3.31	With respect to carbon, steel is intermediate in composition between cast iron and wrought iron.
1273	3.26	The open-hearth process produces a better and more uniform grade of steel than does the Bessemer.
1274	3.17	Pyrite, FeS_2, is often called fool's gold because it resembles gold in color and luster.
1275	3.16	Solutions of nickel salts have a beautiful characteristic green color.
1276	3.15	The essential parts of the operation of the Bessemer converter are the burning out of the carbon, silicon, and manganese.
1277	3.15	In chemical conduct nickel is much less active than iron.
1278	3.07	Ferric oxide constitutes the coloring matter of such pigments as Venetian red, Indian red, and light red.
1279	3.05	The gases issuing from the blast furnace contain chiefly nitrogen, carbon monoxide, and carbon dioxide.
1280	3.00	Sympathetic ink, made from cobalt chloride, becomes blue when warmed.
1281	2.97	Ferric chloride is used as an astringent in medicine.
1282	2.95	In general, acids cause iron to rust while alkalies retard corrosion.
1283	2.89	Iron forms both bivalent and trivalent ions.
1284	2.73	Rouge is obtained by heating ferrous sulphate.
1285	2.72	Steel may be tempered by heating the previously hardened piece (quenched from above 700 degrees C) to the desired temperature.
1286	2.68	Pure or "ingot" iron is used on account of its resistance to rust.
1287	2.65	Ferric chloride is prepared by dissolving iron in hydrochloric acid.
1288	2.64	"Monel metal" is an alloy of copper and nickel with a little manganese.
1289	2.63	The hardness of steel depends in part upon the amount of iron carbide present, and upon the particle size.
1290	2.59	Ferrous sulphate is used in the manufacture of blue pigments, as a mordant, as a fungicide, and in the preparation of black inks.
1291	2.56	Ferrous sulphate is known as green vitriol or "copperas."
		GROUP VIII - A. THE IRON FAMILY (continued)
1292	2.53	Tungsten steels do not lose their temper even at red heat.
1293	2.46	Potassium ferrocyanide and potassium ferricyanide are used in testing for the ferrous and ferric ions.
1294	2.46	In tempering, the temperature of the steel is indicated by the colors of the oxides formed.
1295	2.46	Pure iron is a white lustrous metal, and is very tough.
1296	2.44	Iron was probably mined and refined in Eastern Europe more than 3000 years ago.
1297	2.34	The heat in the electric furnace is due to the passage of the current between electrodes through the slag.
1298	2.29	Cast iron usually contains from 2% to 5% carbon.
1299	2.26	The open-hearth process makes use of the regenerative system of heating.
1300	2.25	Wrought iron is made from cast iron in a reverberatory furnace in an oxidizing atmosphere.
1301	2.18	Manganese is added to steel to make a hard but not brittle alloy used for rock crushers, railroad switches, and safes.
1302	2.17	A small amount of vanadium increases the strength, and resistance of the steel to fatigue.
1303	2.15	The principal ore of iron is hematite mixed with other minerals such as silica and clay.
1304	2.13	In making steel by the Bessemer process the impurities are burnt out and then carbon added to the desired extent.
1305	2.07	Cobalt chloride is blue when dry and pink when moist.
1306	2.06	Russia iron is iron that has been artificially coated with magnetic oxide of iron.
1307	2.04	Magnetic oxide of iron has the formula Fe_3O_4.
1308	2.03	"Ink crystals" consist essentially of nigrosine, which with water makes a solution of ink.
1309	2.95	Cast iron may contain considerable carbon in chemical combination as iron carbide or cementite.
1310	1.93	Iron may be treated with phosphoric acid to cover it with a rustproof layer of iron phosphate.

Number of Item	Index Value	Items
		GROUP VIII - A. THE IRON FAMILY (continued)
1311	1.93	Iron rust is a double compound of ferric hydroxide and ferric oxide, with a small proportion of ferrous bicarbonate.
1312	1.93	The expansion of nickel when heated is as small as that of glass.
1313	1.89	Turnbull's blue is formed by a reaction between potassium ferricyanide and ferrous salts.
1314	1.88	Invar is used for pendulums, steel tapes, and other scientific instruments.
1315	1.88	"Tincture of iodine" is an alcoholic solution of iron chloride.
1316	1.84	Cobalt is a hard magnetic metal, malleable and ductile, and capable of receiving a high polish.
1317	1.66	Cobalt chloride is used in making a cobalt weather chart.
1318	1.66	Ferrous hydroxide is prepared from a soluble base and a solution of a ferrous salt.
1319	1.65	Prussian or Berlin blue is formed by a reaction between a ferric salt and potassium ferrocyanide.
1320	1.64	$Fe_2O_3 + 3\ CO = 2\ Fe + 3\ CO_2$.
1321	1.62	The molten mass of iron in the reverberatory furnace is puddled and gathered into balls called "blooms."
1322	1.61	Almost pure iron is now made and sold as "ingot iron."
1323	1.61	Raw sienna, burnt sienna, raw and burntumber are derived by heating yellow ochre.
1324	1.58	The addition of 3.5% nickel increases the elastic limit of steel.
1325	1.57	Staybright steel is a stainless steel with 18% chromium and 8% nickel.
1326	1.55	The foreign matter present with the iron ore is called the "gangue" and usually consists of sand, clay, and rock.
1327	1.54	$CaO + SiO_2 = CaSiO_3$.
1328	1.54	"Steelite" is used to some extent as high-speed steel on account of its hardness.
1329	1.51	Cobalt nitrate is used in analytical work in testing for certain metals.
1330	1.47	Nickel is used as a catalyst in the hydrogenation of oils.
1331	1.47	Zinc is positive to iron and hence when they are both present in a medium in which they can react the iron is unaffected until the zinc is all gone.
1332	1.45	Phosphorus makes iron "cold short", that is, brittle when cold.
1333	1.45	Sulphur makes iron "red short", that is, brittle when hot.
1334	1.42	Cobalt resembles nickel closely in properties but is more expensive.
1335	1.39	Potassium ferricyanide is known as "red prussiate of potash."
1336	1.39	The most important compound of nickel is nickel ammonium sulphate which is used in electroplating nickel.
1337	1.36	Cobalt and nickel are almost always found together in their natural ores which also contain iron, silver, and copper in combination with arsenic and sulphur.
1338	1.30	Potassium ferrocyanide is known as "yellow prussiate of potash."
1339	1.29	Iron sulphide occurs in nature as pyrrhotite.
1340	1.22	Duriron is an alloy, containing silicon, which resists acid corrosion.
1341	1.22	The alloy of 80% cobalt with 20% chromium resembles silver in appearance, does not tarnish, and is hard and tenacious as good steel.
1342	1.16	Slag is tapped about every two hours and iron about every five hours.
1343	1.06	Invar, steel containing 36% nickel, does not expand or contract appreciably when heated or cooled.
1344	1.00	Platinite, steel with 45% nickel, has the same coefficient of expansion as platinum and glass.
1345	0.98	Ochre or Limonite is a mixture of hydrated ferric oxide, fine clay, and sand.
1346	0.97	Cobalt comes into the market chiefly as cobalt oxide.
1347	0.83	When steel is cooled slowly the iron carbide or cementite separates from the iron.
1348	0.79	Nickel ammonium sulphate is obtained by mixing concentrated solutions of nickel sulphate and ammonium sulphate.
1349	0.74	Siderite is the chief iron ore of England where it is known as clay ironstone.
1350	0.70	"Steelite" contains 55% cobalt, 35% chromium, and 10% tungsten.
1351	0.66	Smalt is a blue pigment of potassium cobalt silicate made by melting cobalt oxide and potassium carbonate with white sand.

Number of Item	Index Value	Items
		GROUP VIII - A. THE IRON FAMILY (concluded)
1352	0.63	Smalt is unaffected by light, the weather, and by acids.
		GROUP VIII
		B. THE PLATINUM FAMILY
1353	6.02	Platinum is used for government standards of length, and in settings for jewels.
1354	5.08	Platinum has important uses as a catalyst.
1355	5.03	Platinum is used extensively in the laboratory because of its indestructibility.
1356	4.41	Finely divided platinum is a catalyst of remarkable power.
1357	4.39	Iridium gives a hard alloy with platinum and is used for pen points, bearings, standard weights and measures.
1358	4.27	Platinum is used in self-lighting cigar lighters.
1359	4.23	Platinum is a white metal about twice as heavy as lead.
1360	3.71	Platinum is not affected by acids, except aqua regia.
1361	2.59	The catalytic action of platinum seems to be in part connected with the property of adsorbing gases and rendering them nascent.
1362	2.09	Platinum, alloyed with osmium and iridium, is found most extensively in the Ural Mountains, California, Alaska, and Australia.
1363	2.05	Platinum is attacked by caustic alkalies, phosphorus, silicon, and carbon at high temperatures.
1364	1.13	Palladium is used in scientific instruments and as a substitute for platinum in jewelry.
1365	0.87	Platinized asbestos is prepared by soaking asbestos with a solution of chloroplatinic acid and then igniting it.
1366	0.66	Chloroplatinic acid is used as a test for potassium compounds.
		GENERAL FACTS, PRINCIPLES, LAWS, ETC.
1367	12.29	The burning of wood is an example of a chemical change.
1368	12.08	Acids turn litmus red and taste sour.
		GENERAL FACTS, PRINCIPLES, LAWS, ETC. (continued)
1369	11.69	Water may be purified by distillation.
1370	11.34	Steam is water in the gaseous state, and is invisible.
1371	10.72	Matter occurs in the solid, liquid, and gaseous states.
1372	10.38	Matter cannot be created or destroyed.
1373	9.92	Distillation consists in changing a liquid to a gas, then cooling the gas so that it becomes a liquid again, and then collecting the distillate in a separate vessel.
1374	9.87	When most metals react with an acid hydrogen is evolved as a gas.
1375	9.56	Elements are divided into metals and non-metals.
1376	9.45	Liquids take the form of the containing vessel, while a solid has its own form.
1377	9.39	An atom is the smallest part of an element taking part in a chemical change.
1378	9.32	A barometer is used to measure atmospheric pressure.
1379	9.23	An element is a substance that cannot be separated by chemical action into two or more simpler substances.
1380	9.14	The metric unit of length is the meter which is equivalent to 39.37 inches.
1381	9.01	Acid should be poured into water.
1382	8.82	Pure water freezes at zero degrees Centigrade and boils at 100 degrees Centigrade.
1383	8.81	When metals are heated in air the product weighs more than the metal.
1384	8.51	Ores are natural deposits from which the elements, especially the metals, are extracted.
1385	8.48	Symbols may be used to indicate elements. (For example, H represents one atom of hydrogen.)
1386	8.33	Two volumes of hydrogen plus one volume of oxygen yield two volumes of steam.
1387	8.24	The combining of hydrogen and oxygen to form water is an example of synthesis.
1388	8.22	Minerals are the elements and compounds whose mixtures make up the inorganic material of the earth.
1389	8.18	A compound is a substance that can be separated by chemical action into one or more simpler substances.

Number of Item	Index Value	Items
		GENERAL FACTS, PRINCIPLES, LAWS, ETC. (continued)
1390	8.00	Substances obtained in any process aside from the main products are called by-products.
1391	7.97	The law of conservation of matter is stated: We are able neither to create nor destroy matter.
1392	7.92	The Centigrade scale is used in scientific work.
1393	7.89	Matter is anything that has weight or occupies space.
1394	7.42	There is some expansion during the solidification of water.
1395	7.37	A chemically pure compound is one from which all of the impurities have been removed.
1396	7.36	When a cloud of dust comes in contact with an oppositely charged water cloud, neutralization takes place and the moisture particles fall as rain.
1397	7.34	Solutions of bases turn red litmus blue.
1398	7.31	In electrolysis the electrode connected with the positive pole of the battery is the anode; that connected with the negative pole is the cathode.
1399	7.15	The density of a substance is its weight per unit volume.
1400	7.01	The separation of a substance into its constituents is called analysis.
1401	6.84	Every pure compound has a definite composition by weight.
1402	6.84	When an equation is balanced there must be the same number of atoms of any element on the two sides of the equation.
1403	6.78	The centimeter is 1/100 of a meter.
1404	6.70	A liquid used to dissolve a substance is called a solvent.
1405	6.69	Atoms do not lose their identities in chemical action; atoms of the same elements are alike; and most atoms have the power of uniting with atoms of other elements.
1406	6.39	A hypothesis is a reasonable guess which when at least partially accepted may be known as a theory.
1407	6.38	A chemical change is a change in which a substance loses the characteristics by which we identify it.
1408	6.33	The atomic weight of an element is a number that expresses the weight of one of its atoms in comparison with the weight of the oxygen atom placed at 16.
1409	6.31	The speeding up of some chemical reactions is aided by catalytic agents.
1410	6.30	Some gases are collected in the laboratory by displacement of air or water.
1411	6.30	Specific gravity is the weight of a volume of a substance compared with the weight of an equal volume of the particular substance taken as standard.
1412	6.14	The red color of sunsets is due to colloidal dust in the atmosphere.
1413	6.07	The metric unit of capacity is the liter which almost exactly equals 1.05 quarts.
1414	6.02	When a supersaturated solution is disturbed the excess solute crystallizes or otherwise escapes.
1415	5.88	A symbol indicates definite weights and volumes of elements and compounds.
1416	5.79	Equations may be written to show the weights or volumes of the reacting materials, and the weights or volumes of the products formed.
1417	5.75	A salt is a metal joined with an acid radical.
1418	5.74	Equations may be called chemical shorthand.
1419	5.68	A molecule is the smallest part of a gas which has the chemical properties of the substance.
1420	5.65	The property of an atom which determines how many atoms of any other kind it can hold in combination or can displace in a reaction is known as valence.
1421	5.62	A gas is at standard conditions when its temperature is at zero degrees Centigrade and it is under a pressure of 760 mm. of mercury.
1422	5.61	An ion is an atom or group of atoms carrying an electric charge.
1423	5.58	If the temperature does not change, the volume of a gas varies inversely as the pressure exerted.
1424	5.57	A base is a hydroxide of a metal or of a metallic radical whose water solution contains hydroxyl ions.
1425	5.49	A gram molecular weight of any gas has a volume of 22.4 liters at standard conditions.
1426	5.46	Materials, like washing soda, that lose their water of crystallization when exposed to the air are said to be efflorescent.

Number of Item	Index Value	Items
		GENERAL FACTS, PRINCIPLES, LAWS, ETC. (continued)
1427	5.44	A base is a hydroxide of a metal or metallic radical.
1428	5.22	All atoms are composed of positive charges of electricity called protons, and negative charges of electricity called electrons.
1429	5.22	The strength of an acid or base depends upon the degree of ionization it undergoes in solution.
1430	5.17	Avogadro's hypothesis is that equal volumes of gases under like conditions of temperature and pressure contain the same number of molecules.
1431	5.11	The heat used in changing ice to water at the same temperature is known as the heat of fusion.
1432	5.10	All of the substances that we know as acids produce H+ ions when they enter solution.
1433	5.10	The Periodic Law has been of great service in the development of a systematic study of the elements.
1434	5.05	There is molecular motion in gases, liquids, and solids.
1435	4.96	The heat used in converting water into steam under the same conditions is known as the heat of vaporization.
1436	4.95	The Law of Multiple Proportions is: when two elements unite to form more than one compound, the weights of A which join with a fixed weight of B bear the relation of simple whole numbers.
1437	4.93	An acid is a hydrogen compound whose water solution contains hydrogen ions.
1438	4.92	A chemical family is a group of elements which show the same valence and progressive changes in properties toward metallic character as atomic weights increase.
1439	4.91	Fogs are liquid droplets in gases.
1440	4.72	Sublimation is the passing of a substance from the gaseous to the solid state without formation of a liquid.
1441	4.70	Electricity is not the cause of dissociation, but simply determines the direction in which the charged particles move.
1442	4.66	The Periodic system has been of value in predicting the discovery of new elements.
1443	4.66	Many elements, such as oxygen, are more active at the instant of liberation from their compounds.
		GENERAL FACTS, PRINCIPLES, LAWS ETC. (continued)
1444	4.64	The concentration of acid refers to the percentage of acid present in the solution.
1445	4.64	The products of neutralization are heat, water, and a salt.
1446	4.62	Acids react with certain metals or their hydroxides to form salts.
1447	4.61	Electrolytes, when placed in solution, dissociate into particles called ions.
1448	4.58	If the pressure does not change, the volume of a gas varies directly as the absolute temperature.
1449	4.57	The atoms of elements frequently have a capacity for combining to form compounds.
1450	4.55	A deliquescent substance absorbs sufficient moisture from the air to become wet.
1451	4.53	The amount of solute capable of being dissolved by a solvent depends upon the substances, temperature, and pressure.
1452	4.50	A gas contracts 1/273 of its volume at zero degrees Centigrade for each degree it is below zero degrees C.
1453	4.49	A gram-molecular weight of any substance is a weight in grams that is numerically equal to the molecular weight of the substance.
1454	4.41	Electrolytes are more active chemically than non-electrolytes.
1455	4.41	The electrochemical series is an arrangement of the metals such that each will displace from solutions of their salts those below it in the list.
1456	4.39	The two most common dispersed systems are suspensions and emulsions.
1457	4.38	The traveling of one gas into the other until there is a uniform mixture is known as diffusion of gases.
1458	4.34	The water that unites with a substance when it crystallizes is known as the water of crystallization.
1459	4.32	When a solvent has dissolved all the solute it is capable of at that temperature, it is said to be saturated with respect to that substance under existing conditions.
1460	4.29	The mud in a stream is coagulated by the effect of the salt water into which it flows and a delta is formed.

Number of Item	Index Value	Items
		GENERAL FACTS, PRINCIPLES, LAWS, ETC. (continued)
1461	4.28	The elements in one of the vertical series in the Periodic Table have certain resemblances.
1462	4.24	A hygroscopic substance is one that absorbs moisture from the air.
1463	4.22	A dissolved substance is called the solute.
1464	4.22	The great service of atomic numbers is in the explanation they give of the nature and cause of chemical action.
1465	4.18	The Periodic system has been used in the adjustment and revision of atomic weights.
1466	4.14	The temperature -273° C., which denotes the total absence of all heat, is called the absolute zero.
1467	4.08	The percentage of any element in a compound can be calculated from the formula of the compound.
1468	4.08	Most gaseous elements contain two atoms in a molecule.
1469	4.08	In the Periodic Table most of the vertical groups contain two families, and the elements belonging to the same family resemble each other closely.
1470	4.02	Gay-Lussac's Law is: the relative combining volumes of gases, and the volume of the product, if gaseous, may be expressed by small whole numbers.
1471	3.99	The coefficients in a chemical equation may represent volumes of the gases.
1472	3.99	The vapor density of a gas is its specific gravity with hydrogen as standard.
1473	3.98	The four chief types of chemical action are, simple decomposition, single replacement, double replacement, and direct combination.
1474	3.95	The kilogram, the metric unit of weight, equals 2.204 lbs.
1475	3.95	Oxidation involves an increase in valence, while reduction involves a decrease in valence of an element.
1476	3.87	The heat of formation is the number of calories of heat absorbed or liberated during the formation of a gram-molecular weight of a compound from its elements.
1477	3.82	The formula HCl represents one gram-molecular volume of hydrogen chloride gas.
1478	3.79	The atomic number of an element, as determined by its X-ray spectrum, denotes its position in the series of elements.
1479	3.70	The heat of neutralization is the heat evolved by the formation of water from hydrogen and hydroxyl ions.
1480	3.69	The molecules of solids vibrate within certain definite limits about a position to which they always return.
1481	3.69	In electrolytes, the valence of an ion is numerically equal to the number of charges carried by it.
1482	3.60	Mendelejeff, a Russian chemist, gets the credit for the Periodic Law.
1483	3.57	Elements at the instant of liberation are said to be in the nascent "being born" state.
1484	3.55	Degree of dissociation is measured by degree of electrical conductivity.
1485	3.49	A solution is a uniform mixture that does not follow the law of definite proportions.
1486	3.49	Hydrolysis is a reversal of neutralization.
1487	3.48	The number of electrons an atom can lend as a metal or borrow as a non-metal is known as its valence.
1488	3.47	In order for a reaction to go to an end one of the products formed must leave the field of action.
1489	3.47	The properties of the elements change with increasing atomic weight, and elements of similar properties appear at definite intervals in the Periodic classification.
1490	3.46	A colloidal solution shows the path of the beam of light because the particles reflect light (Tyndall effect).
1491	3.45	The Periodic Law has imperfections, as, no place for hydrogen, and the similarities between the elements in a family are general and not exact.
1492	3.26	$2\ H_2O + O_2 = 2\ H_2O_2$. This formula represents a case of synthesis.
1493	3.22	When a chemical change takes place without the addition of heat from an external source the substance that has the greatest heat of formation will form.

Number of Item	Index Value	Items
		GENERAL FACTS, PRINCIPLES, LAWS, ETC. (continued)
1494	3.15	The adsorbent (catalyst) attracts to its surface both reacting substances, which, brought into intimate contact, combine more rapidly than they would otherwise.
1495	3.13	The coefficients in a chemical equation may represent volumes of the gases.
1496	3.12	$2\ H_2O = 2\ H_2 + O_2$. This formula represents a case of analysis.
1497	3.00	The Periodic Law is a comprehensive classification of the elements.
1498	2.91	The hydrogen in an acid may be replaced by metals above hydrogen in the electrochemical series.
1499	2.86	The positive element is used first in naming a compound.
1500	2.86	The period of alchemy is noted as the attempt to discover the philosopher's stone with the help of which all base metals, such as tin and lead, could be converted into gold.
1501	2.85	Colloids are suspensions of matter intermediate between the extremely minute particles of true solutions and the larger aggregations that settle on standing.
1502	2.84	All catalytic agents are adsorbents.
1503	2.80	Formulas which give us some idea of the arrangement of the atoms, as H-O-H, are called structural formulas.
1504	2.78	When chemical action is proceeding in one way as fast as in the other, we have a condition known as dynamic equilibrium.
1505	2.75	Reducing agents tend to produce action in which valence is lowered.
1506	2.63	$CaCO_3 + 2\ HCl = CaCl_2 + H_2O + CO_2$.
1507	2.56	Many of the plastics are called cements when they come into the market as powders.
1508	2.54	Metals having electrons to lend will join with non-metals desiring to borrow electrons. (For example, sodium joins with chlorine to form sodium chloride.)
1509	2.52	A group of atoms which act like a single atom is called a radical.
1510	2.49	Reactions may go to an end through volatility, insolubility, and nonionization.
1511	2.48	If we know the percentage composition of a compound, we can calculate its formula by dividing the parts by weight of each of the elements in the compound by its

Number of Item	Index Value	Items
		GENERAL FACTS, PRINCIPLES, LAWS, ETC. (continued)
1511	2.48	(continued) atomic weight. The result is the relative number of each of the elements in the compound.
1512	2.44	There are enough electrons arranged in shells outside the nucleus to balance the excess protons in the nucleus.
1513	2.44	In measuring gases over water we must correct for difference in level, and pressure of water vapor.
1514	2.44	In a structural formula each valence is represented by a dash or bond leading from the symbol of the element considered.
1515	2.43	Oxidizing agents tend to produce actions in which valence is raised.
1516	2.41	In colloids the dispersion and dispersed mediums may be either solids, liquids, or gases.
1517	2.41	Long and short periods are used in the periodic arrangement of the elements.
1518	2.36	The opposite of gelation (coagulation) is peptization (going back into solution).
1519	2.34	The less electrons an element has to borrow or lend the more active it is chemically.
1520	2.27	The valence of an ion is raised by oxidation and lowered by reduction.
1521	2.19	The formula HCl represents 1 part by weight of hydrogen, 35.5 parts by weight of chlorine, and 36.5 parts by weight of hydrogen chloride.
1522	2.01	Gelation (coagulation) of a colloid means increased size of particles, loss of Brownian movement, and, ultimately, crystallization.
1523	2.00	The plastic is a gel and is governed by the same principles.
1524	2.00	Some elements, helium for example, are very inactive because their outer shell is complete.
1525	1.94	Fractional atomic weights are explained by the fact that the elements having these fractional weights have been shown to be mixtures of two or more isotopes, and each individual isotope has an atomic weight.
1526	1.94	An oxide which unites with water to form an acid or a base is called an anhydride.
1527	1.93	The equation $KClO_3 = O_2 + KCl$ may be balanced thus, $2\ KClO_3 = 3\ O_2 + 2\ KCl$.

Number of Item	Index Value	Items
		GENERAL FACTS, PRINCIPLES, LAWS, ETC. (continued)
1528	1.90	Colloids do not diffuse or dialyze through membranes.
1529	1.89	The difference between colloid and crystalline material is in the degree of dispersion, the size of the particle, and the development of surface.
1530	1.85	Liquid mixtures that contain colloidal particles in suspension are called sols.
1531	1.84	The Law of Mass Action may be stated as: The speed of a chemical action is increased in a given direction by increasing the concentration of one of the substances that produce the action.
1532	1.84	Varieties of the same element which differ in physical properties are called allotropic forms.
1533	1.81	Formulas of the type H_2O are known as empirical formulas.
1534	1.63	Elements having the same chemical properties, but possessed of different atomic weights, are called isotopes.
1535	1.63	Isomers are compounds having the same percentage composition, but possessing different properties on account of differences in the arrangement of the atoms in the molecules.
1536	1.54	The number of electrons outside the nucleus is equal to the atomic number of the element.
1537	1.52	A gram-molecular weight of any gas at standard conditions has a volume of 22.4 liters.
1538	1.51	Crystalloids diffuse through membranes.

Number of Item	Index Value	Items
		GENERAL FACTS, PRINCIPLES, LAWS, ETC. (concluded)
1539	1.47	Colloids show greater chemical activity than the solid substance.
1540	1.45	Elements that have identical atomic weights, but different chemical properties, are called isobares.
1541	1.32	A protective colloid prevents the particles from coming into larger aggregations which settle.
1542	1.32	An essential condition for the stability of a colloid is that the material be insoluble in the dispersion medium.
1543	1.27	Some elements will both borrow and lend electrons, and are said to show amphoteric properties.
1544	1.24	The portion of the acid molecule remaining after all replaceable hydrogen has been removed is called an acid radical.
1545	1.21	$H_2SO_4 + 2\ KOH = 2\ H_2O + K_2SO_4$.
1546	1.17	Colloids are prevented from settling by a vibratory movement that is known as the Brownian movement.
1547	1.12	If the valences of two elements which join together to form a compound are different, the total number of electrons borrowed or lent is the least common multiple of the two valences.
1548	1.10	Colloids are highly charged because they show a great surface, and the amount of electrical charge depends upon the amount of surface.
1549	0.87	Atoms which have the same atomic number but different atomic weights are known as isotopes.
1550	0.85	In colloids, the solvent of the true solution is here called the dispersion medium, and the solute is called the dispersed phase.

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